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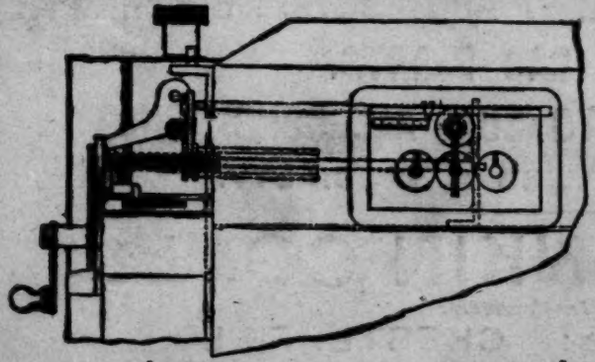
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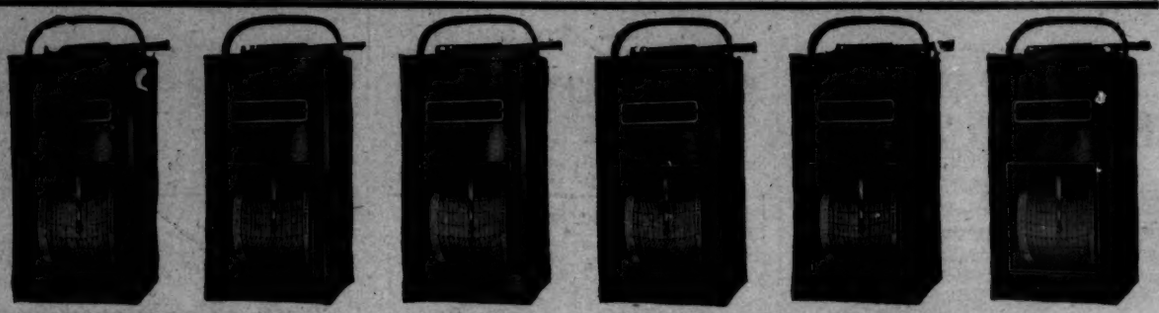

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EDITORIAL NOTES.

Gas Bills in Parliament.

WE complete to-day our review of the Gas Bills that have been promoted for the coming session. Most of them have their individual and interesting features; and, taking them as a whole, they point to the lines of the gas industry's development, and of legislative needs. Speaking generally, Parliament has, when powerful interests are not brought to bear, been more pliant of late years in the matter of receding from laws, fashioned in other times and under other circumstances, relating to the gas industry. Conservatism is good up to a point, but not when it takes a hostile attitude in relation to the mutations brought about by time, fresh discovery, and advances within an industry, as well as in respect of external influences brought to bear adversely upon the industry. We had something to say last week regarding the statutory financial conditions under which gas undertakings are operating, and as to the modifications towards greater elasticity and opportunity that general circumstances now demand shall be extended to the industry. No industry can serve the nation and the public to the best advantage if it is kept in a worse state than other industries in respect of the provision of capital and loans. One cannot work if one is starved; and so the gas industry must be placed in as good case in every way as any other industry or commercial undertaking. However, we believe that, in the industrial and commercial renaissance that the war is producing, and that pictures for us a greater Great Britain fighting for and defending its own life and prosperity giving resources, Parliament now recognizes that there must be larger freedom, and that broader principles must prevail. Certainly, this must be so in an industry exposed to competition in all quarters such as is the gas industry, and yet an industry whose very operations (as the Government now realize through the war) are necessary in order to provide fundamental and therefore essential materials for several other industries.

A larger liberty there must be—in regard to finance, trading conditions, and the making of the best economic use of opportunities. In connection with the gas business, a frequent request to-day is for sanction to the making of differential charges without giving preference under like circumstances. In almost every instance, too, the illuminating power standard is being abandoned by promoters, and the calorific value one is being adopted. All through the Bills on this occasion, promoters have forsaken the complication of a margin in the standard, and have favoured a definite standard of 500 B.Th.U. (total heat test), with one exception—the Aberdare and Aberaman Company, who ask for a marginless standard of 475 B.Th.U. If we mistake not, they will get it, inasmuch as in 1914, in the Bedwas and Machen Act and in the Porthcawl Act, Parliament allowed a standard of 540 B.Th.U., with a margin of 12 per cent., which brings the penalty-line down to 475 B.Th.U. In both instances, the request was allowed on the ground of the uncertainty with the local coals of being able to work with safety to a 500 B.Th.U. penalty-line. In the case of residual products, too, the road of development is clear. The country would have been in unenviable condition to-day, if the gas industry generally had been boxed-up in the manner another industry desired, but which, with excellent judgment, declines to subject itself to statutory restrictions. In certain quarters, Parliament listened. Parliament must to-day be thankful that opportunity did not permit it to proceed further than it did in shackling the industry in the matter of free working and trading in gas residuals. The war and national necessity have compelled an expansion of both working and trading in residuals within the industry; and last year saw Parliament in cases hesitating to commit further mischief by pressing for the one-third restriction. Certain Bills deal with the new situation that has been created by the country's requirements; and Parliament must see that in this matter national resources are expanded and not limited. This is one of the lessons for the Government and Parliament that has come out of the profoundly ominous situation in which the country found itself not many months since in regard to the supply of high explosives; and we hope that the lesson will not be lost upon Committees this coming session. Freedom in this matter means greater national security and public benefit.

In the expanding opportunities of gas undertakings, the process continues of the larger absorbing the less, and service to the public thereby promoted. The Folkestone Gas Company are annexing the Hythe and Sandgate Company; the Uxbridge Company, the Eton Company; and the Aberdare and Aberaman Company, the Hirwain Company. This consolidation of interests is always succeeded by economic advantages, in which the gas consumers in the smaller areas materially benefit—at any rate, this has hitherto been the invariable outcome. In every way, the legislation of the times points to the realization of greater freedom being a necessary factor in modern progress and in enabling competition to proceed on terms of equality with other industries. Freedom also means a greater power of resistance where in the commercial struggle the heaviest pressure is felt.

Sulphate of Ammonia in War Time.

EVERYBODY can sympathize with Messrs. Bradbury and Hirsch in the disabilities under which they have laboured in preparing their review of the sulphate of ammonia market in 1915. They have incomplete statistical information; and their explanations of the movements of the market are more or less matters of hypothesis, with interest imparted to them by the knowledge that there are few people better placed for bringing hypothesis fairly closely up to the line of actuality. The war has entirely displaced definiteness from the components forming the foundation for a report of this kind; and the conditions are unique and altogether fictitious.

For instance, the estimate of home production for the year is only presented as the most proximate figure, in the absence of positive returns that can be arrived at. The total is 423,000 tons, or 3000 tons less than in 1914, and 9000 tons less than in 1913. In producing 173,000 tons, gas undertakings are charged with having been responsible for contributing 3000 tons less than in 1914; 9000 tons less than in 1913; but 1000 tons more than in 1912. Iron-works are credited with having produced 16,000 tons—the same as the previous year—and shale-works with 58,000 tons, or 5000 tons less than in 1914. This decline in the latter's output is counterbalanced by the larger yield of coke, carbonizing, and producer gas plants—viz., 176,000 tons, compared with 171,000 tons. The point of interest about this figure is something that for years past we have seen approaching, and that is the time when the coke and carbonizing plants as a class would in the magnitude of production take place superior to gas undertakings. This has now happened—according to the computation, and for an exceptional year; for the 176,000-ton yield of the coke and carbonizing plants is more by 3000 tons than that of the gas undertakings. However, if pride there was in respect of being the superiors in point of production, then we can look for consolation to the last normal year's working—1913—and there see registered 182,000 tons as the total yield from the working of gas undertakings. But position in the matter of magnitude does not trouble us. What is more important is that the demand should be developed so as to keep pace with the whole supply; and we say frankly that, after the war, we do not see how this is to be done without very strenuous and persistent work, in view of increased competition. As Messrs. Bradbury and Hirsch remark, while it is possible

now, with eighteen months' experience of the war, to adjust matters in respect of the sulphate of ammonia market to the current abnormal conditions, great readjustment will again be required with a reversal to peace conditions.

There is no possibility of judging on the data now presented what will happen hereafter. We depend on export business for the disposal of something like three-quarters of our home production. This is a very serious proportion. With Germany out of the running, things are fairly plain sailing and favourable, except in the matter of freights. But with all drawbacks to foreign business, exports were well maintained last year. They amounted to 294,308 tons of the total produced, being 19,000 tons less than in 1914 and 30,000 tons less than in 1913; but something like 7500 tons higher than in 1912. There are rather strong grounds for believing that dealers in Holland and Sweden were at one time acting as intermediaries in supplying Germany with British production, which helped to swell our overseas business; but our Government is now very properly exercising a more stringent supervision in this direction. The sugar-growing countries, too, were magnificent customers. When it is seen that (with Holland) Java, British Guiana, West Indies, and Mauritius took during the year 161,974 tons, which was nearly twice as much as in 1914 and the odd figures alone over 100,000 tons more than cover the combined shipments for any previous year, we have facts that should arrest attention. Japan was a very small purchaser during last year, partly owing to the prohibitive freights, and partly to other causes; and the United States also fell away considerably. But if Japan had bought as largely as in previous years, Messrs. Bradbury and Hirsch point out that there would have been, without question, a sulphate of ammonia famine, and prices would have gone ramping up to higher levels still. If, on the other hand, the sugar-growing countries had not come to our aid, sulphate of ammonia producers would have been in a very unpleasant position—there would have been a glut of supplies, and a slump in prices. A study of the figures shows how careful will have to be the handling of the future when Germany is again a competitor, with its gas, coke-oven, and synthetic processes all putting on to the market large supplies of sulphate. But there is, so far as portents can be read, favourable ground for belief that the stability of the market in the immediate future will be maintained—that is to say, while present conditions rule—and good prices will so long continue to be realized. That they will remain at the existing high level, however, is open to doubt, notwithstanding home requirements, including those for munition purposes. The reason for doubt is that Messrs. Bradbury and Hirsch fear that there has been somewhat heavy buying on an advancing market for early delivery; and, if this is so, there may be a set-back in prices when the summer months are reached. There is, however, the sulphuric acid question, which is becoming more and more acute, and which may affect production; and there are also great inducements to fertilize in view of the increasing demands of the world for foodstuffs. Nevertheless, it would, all things considered, be imprudent to anticipate that a figure of anything like £16 7s. 6d. per ton with which the past year closed, or the higher figures with with this year has opened, will pursue an uninterrupted course, unless demand outruns the available supplies. The past year will, however, stand out for the energy displayed by prices in ascending from what had come to be regarded as about a normal figure to the beforementioned £16 7s. 6d. per ton, and an average for the year of £14 9s. 3d., for the equal of which we have to go back more than thirty years.

Nitrate of soda (to say nothing of other fertilizers, which on this occasion the reporters ignore) has also done well in regard to price, but not in the bulk of dealings compared with pre-war years. Germany and Belgium have been shut-out from the market, or largely so, except in respect to such quantities as could be obtained by the former by the back-doors provided by neutral countries; and, before the war, the two countries were considerable purchasers. But the available supplies to meet the demands of the year have been such that prices have also gone up; but still those ruling in October and at the end of the year are regarded as having been unduly inflated. Freights, of course, have had their effect; but, even allowing for this, there was no real justification for the prices obtained. There are large stocks that can be released; there are considerable quantities waiting an outlet from the Panama Canal which has been blocked owing to an accident. When the canal is re-opened, these stocks will be liberated, and the way will be opened to quick transport of further supplies. This being so, unless output is restricted (despite requirements for munition purposes), it will be impossible to maintain the values that have lately been commanded. To some extent this would react on the sulphate of ammonia market. On the whole, however, in regard to the latter commodity, there is reason for present congratulation. But under such circumstances, let us not forget the future.

Impolitic Legislation in France.

It is not an agreeable task to criticize in any way the doings of the Government of such a close Ally as is the French nation; but from information collected from one of our French contemporaries (as summarized in other columns), there is good ground for doing so in relation to matters affecting the public generally, and the (from our point of observation) French gas undertakings particularly. It was only on Dec. 28 (pp. 696, 703) that we were congratulating our colleagues of the gas industry in France on the very sensible attitude that the Government were taking in regard to the question of gas contracts and charges in relation to any (really immaterial) deterioration of town gas that might arise as a consequence of the extraction from it of a proportion of its benzol and toluol content. The Government very properly look upon this as a national service, the results of which, whatever their nature, must be borne by the public generally, and without in any way affecting contracts. While we were congratulating the Government upon taking this extremely politic legislative course, it now appears that at that very time the Chamber of Deputies had other legislation on the *tapis* which also affects gas undertakings, and which appears to us to have about it the characteristics of being impolitic, unjust, and loose. In the measures to which exception is being strongly taken, the Chamber of Deputies are proposing to deal with effects and not with causes; and obviously the methods of doing this have been framed without any consideration as to their consequences, apart from the special one aimed at. The machinery, too, which they are intending to set-up so as to carry out their object is of the most ineffective kind that could well be imagined for the purpose in view, and just of the sort that is more likely to result in decisions which will be distinguished more for their variety in degree than for their common sense. It is proposed that prices of commodities, including those for lighting and heating, shall be fixed; the intention, of course, being to protect the public against inflated prices. The object is right enough; but it should be sought by other means than in the comprehensive and drastic manner that is proposed by the Chamber of Deputies. Those upon whom will fall the duty of fixing prices are the Mayor, or, if circumstances so direct, the Prefect of Police, with the assistance of an Advisory Committee drawn from Chambers of Commerce and Agricultural Syndicates.

Gas undertakings deal with several commodities other than gas; and we cannot imagine, unless the local gas undertaking is a municipal possession, that the Mayor or the Prefect will not keep a stricter eye on the pockets of the public than upon justice to the gas undertakings. There will undoubtedly be considerable variations in the views of the amateur tribunals as to what is right or wrong in this matter; and decisions will, we are afraid, be partly swayed by other factors than legitimate circumstances. If they were really governed by the whole of the circumstances, there might not be any particular ground for complaint; but the chances are greater that they will not be than that they will be. As to gas, it seems to be thought in the Chamber of Deputies that the contracts prevent any variations being made in the charges. But if the Government have regard to the regulation of prices on one hand as a matter of justice, they ought also to see whether the extraordinary circumstances of the times do not warrant the contract prices for such a commodity as gas being dealt with, in order that, through high coal prices and extraordinary freight and transport charges, the very life may not be squeezed out of undertakings that are in these exceptional times doing their utmost to serve the public and the country well in more ways than one. If the Government are anxious to carry out some constructive legislation, they could not do better than look into the conditions of the gas undertakings which are so actually engaged in public and national service, and see that their position for maintaining effective work is in no

way unnecessarily impaired. The legislation in question has not yet (according to our latest information) been confirmed by the Senate; and it is to be hoped it will receive very drastic amendment before it is.

The Government are also proposing to exercise control over the supplies of fuel by instituting a central body for the purpose, with sub-bureaus in all mining districts and at the various ports. It seems that even the coal secured by railway companies and gas undertakings are to come under the general supervision of the proposed organization. The Government must have a care that they do not do more harm than good so far as the latter are concerned. Anyone who has studied the coal position in relation to France can readily see that what is proposed is tantamount to beginning at the wrong end. Regulation of prices at home sources (such as are available) may be feasible; and an attempt to get easier terms from the British coal industry and better control of freights, home transport, and labour required in unloading and distribution, would be constructive means helping towards very greatly improving the position. The Government are certainly in these matters going to work in anything but the best way, and will be simply producing a large amount of discontent where mutual aid should exist. Certainly for gas undertakings with fixed prices for gas, the regulation of prices for secondary products, and possible interference with coal deliveries, will only make confusion worse confounded.

Standards for Factory Illumination.

THERE is one thing against which the lighting industries devoutly hope they may be protected as an outcome of the investigation by the Departmental Committee appointed by the Home Office, into the large question of the lighting of factories and workshops; and it is that there will be no attempt at a finical individual standardization of illumination for the innumerable processes and operations that go to make up British industry. There is danger in superfluity where enthusiasts in any particular line of work are concerned; and there have been signs more than once of this danger developing in connection with the inquiry into factory and workshop lighting, with the result that there have been disquieting visions of tables containing masses of prescribed values for all classes and orders of work. But there has always been the comforting reflection that, if any essay was made in this direction, the very immensity of the work that would be involved would be a fit and proper punishment for those who sought to launch upon the owners of factories anything more than the most general illumination standards. We have never been able to see that there was any reason or necessity for anything more than the latter; and the farther we go into the matter, and see the vast incomparability that exists all through the industries, the more hardened do we become against anyone who talks of trying to perform the miracle of making the more or less rough-cast and inharmonious circumstances of factories and workshops comply with an exactitude that can only be secured in the placid atmosphere and under the regulated conditions of the laboratory.

But whatever may once have been the aspirations in regard to an illumination prescription for every process and operation, those who have so aspired appear to be bending under the force and weight of actual circumstances. These circumstances in their variety alone are overwhelming; and they are, it seems to us, performing the good service of bringing the ultraist down to the practical level of considering the sufficiency of general prescriptions. Some indication of this was obtained at the Royal Society of Arts last Tuesday evening. The occasion was the reading of a paper by Mr. J. S. Dow, before the Illuminating Engineering Society, on "Some Principles in Industrial Lighting." We do not suggest that Mr. Dow ever has been an extremist in anything; but he is in close touch with the illuminating engineering movement, and knows well what some votaries of scientific illumination have placed before themselves as an ideal in this particular matter. It is interesting, therefore, to find him saying, after having examined closely a booklet containing figures issued a few years ago in America in regard to the illumination practices of various trades, that "one is "inclined to think that perhaps it is hardly necessary, with "our present knowledge, to attempt to discriminate quite "so closely as in this production between the requirements "of different operations." One notices that Mr. Dow is somewhat circumspect as to the manner in which he says this. Perhaps he does not want to tread on sensitive corns; perhaps he does not wish to anticipate any expression of view on the part of the Departmental Committee (which we hope will come from them in due season) that their investigation assures them of the impracticability and, in fact, the needlessness and uselessness, of doing more than prescribe illumination standards in the most general terms. Then Mr. Dow suggested that perhaps the rough classification contained in the recently issued code prepared by a Committee of the American Illuminating Society might serve as a useful guide. The code suggests that for storage, passageways, stairways, and the like, the minimum illumination should be 0·25 foot-candle; for rough manufacturing and other operations, 1·25 foot-candles; for fine manufacturing and other operations, 3·5 foot-candles; while for special cases of fine work a desirable illumination would be from 10 to 15 foot-candles. Mr. Dow suggests that almost all industrial operations might be classified under one of these heads, so far as the amount of illumination required is concerned, though he qualifies this by saying that merely specifying a certain illumination on the work is not sufficient to secure "adequate and suitable lighting." The illumination must also comply with the requirements in regard to uniformity of illumination over the working area, and avoidance of glare and inconvenient shadows. Mr. C. C. Paterson, of the National Physical Laboratory, also stated that the more one saw of factories, the more one was impressed with the view that it was not very necessary to have lighting tables, and that to specify a standard for rough and fine work would be sufficient, with the exception of such cases as work on any dark materials, for which a much higher illumination is necessary.

It is hoped that these are the indications of a tendency to workable general prescriptions, and away from an absurd individual specification for practically each and every process and operation. There is no necessity for anything of this kind, especially in these days when illumination, using modern types of lamps, is so cheap that in enclosed places a liberal illumination (liberal without glare) can be quite economically provided that will cover work in the categories of rough, fine, and superfine, as well as the optical requirements of individual workers. If the result of the labours of the Committee is the levelling-up of the standards of illumination for work to those mentioned by Mr. Dow, it will be an excellent one; for, as the third volume of the report of the Committee has shown, there exists in factories to-day such a variety of degrees of illumination for the same classes of work that if the high ones are right, then those below must be wrong, and the lowest ones exceedingly bad. The question of factory illumination, in view of diverse environment and conditions, is complex enough already. Therefore the simpler and more general the prescriptions of standard illumination can be made the better, and the more likely are they to be adopted. Multiplicity means confusion; and the easier the way is made to reform, the greater and quicker the accomplishment.

Naphthalene Experiences at Ramsgate.

Naphthalene, even with the "C" process in operation for the recovery of toluol from the gas, is occasioning no concern at Ramsgate; and the reason is explained in a short article by Mr. William Thomson and Mr. R. H. Ruthven, which appears on p. 139 of this week's issue. Two-and-a-half years ago, they adopted very simple and inexpensive means of dealing with what had been previously a very acute trouble. Apparatus is employed which atomizes a light hydrocarbon oil; and the gas is brought into intimate contact with it. A sketch accompanying the description is explanatory of the whole arrangement. "While we cannot claim," write the contributors of the interesting experience, "complete immunity from naphthalene troubles, yet with a reduction of from 350 to less than 20 in the weekly number of complaints, we think we have got the trouble well in hand." The testimony is highly satisfactory.

The Gas Consumer and Toluol.

In connection with the extraction from gas of benzol and toluol for munition purposes, there has lately been good cause for adopting the attitude that the gas consumer should be informed as to the part that he is individually taking, through his use of gas, in providing the source of something that is of inestimable

value to our Armies and our Navy. So long as there was any mystery about the matter, and busybodies and agitators existed, so long the consumer would naturally believe, or be invited to believe, that he was being in some way deprived of value, though there might be no visual or other experience of any depreciation. As we have recently pointed out, this feeling had commenced to show itself; and it was quite time the consumers were told the part they were taking in making provision of essentials for the war, and yet how little, using gas in modern ways, they were being affected. In the "Daily Telegraph" and other papers yesterday, there appeared an article headed "Explosives from Gas. Appeal to Consumers. A Patriotic Duty." It is exactly what is required for the information of consumers; and we suggest that managers of gas undertakings should get it reproduced in every newspaper in their areas of supply. There is nothing in the article that can be of service to the enemy; for what the enemy does not know about toloul extraction from gas, we rather fancy, is not worth knowing. What has been done in this country has been, and is being, done in Germany; so what has to be done here is to make the utmost use of our larger resource in town gas supply. The article acknowledges how loyally the gas undertakings are working in this country; and it tells the consumers how they can show their patriotism and loyalty, by burning as much gas as possible instead of coal, and by, if there should be any slight inconvenience, treating it as an occurrence resulting from complying with service in a national cause.

Complaint and Profit.

On the point of complaint, and touching the notion that a few disturbers of the peace have been trying to promulgate as to gas undertakings making large profits out of the extraction of toluol from gas, the following is an excellent statement, and illustrates the general character of the article: "But, though the direct inconvenience to the public has been small, complaints have been made freely, and a certain suspicion seems to be entertained that the gas companies are extracting these products from the gas to their own profit and to the detriment of the consumer. Nothing could be further from the truth. The gas companies have in nearly every instance had to arrange for the installation of new plant; and their engineers have had to devote considerable time and energy to teaching the process. The sum-total of the capital outlay that has been voluntarily borne by the many companies working the process has reached a very large figure. The inconvenience to the consumer, as has been said, is in the great majority of cases unnoticeable."

A Fixed Rate.

A suggestion, the adoption of which, if it proved practicable, would be hailed with relief by myriads of harassed ratepayers who, under present conditions, find it a matter of impossibility to determine with any degree of accuracy what their future liabilities are likely to be, was lately made in a Liverpool paper by a writer signing himself "Surveyor." The matter dealt with is the rates question—"one which hits all classes, and often hits hardest the most deserving"—and the article was apparently prompted by rumours of an increase in the Liverpool rates. Pointing out that in the last dozen years or so the rates in Liverpool have advanced about 40 per cent., the author asks whether this increase is to go on perpetually, or whether it is not possible to fix a high-tide mark beyond which the rates shall never rise. A fixed comprehensive civic rate, which he urges Liverpool to adopt, seems to him to be a sane and businesslike suggestion that should be readily accepted by those in authority as the main road by which efficiency in civic administration is to be secured. It is, of course, an obvious fact that economy is being enforced in the home and in the business house, and in both cases it is found not only desirable but absolutely necessary to impose hard-and-fast limits on expenditure.

And Economy.

Some means may be found of applying the maximum expenditure rule in the case of our local governing bodies. Indeed, the statement has been made by a member who some years ago in the Liverpool City Council raised the question of a fixed rate, that the idea is successfully practised in many modern and progressive American cities. Judging from some of the discussions upon public lighting which get reported in the Press, one would be inclined to think that councillors had determined to make their first aim a curtailment in the expenditure of the ratepayers' money. Incidentally, the discussions sometimes tend to show that even economy may be too dearly bought; but that is not exactly what is now being considered. The point of "Surveyor's" article is that for the present year the rates should be got within such a figure as stringent economy would reduce them to; and that then the different departments should be told that they must adhere to this amount, so that it would be a fixed rate for years to come. Provided the rate were put at a sufficient figure to ensure efficiency, the system would possess advantages; for under prevailing methods the tendency of rates is so often upwards, and so seldom downwards.

Gas Consumption Figures in Manchester.

Reference has been made in the preceding paragraph to reductions, and proposed reductions, in public lighting which have been inspired by the desire to economize. But it must be remembered that there are a far larger number of places in which the illumination of the streets has been reduced on a drastic scale by order of the authorities. For instance, at Manchester, during the nine months ended Dec. 31, the gas consumed in the city and outlying places supplied by the Corporation shows a decrease of 2·88 per cent., compared with the corresponding period of 1914, when an increase of 3·11 per cent. was recorded. This decrease is regarded as being entirely attributable to the effect of the restricted lighting order which came into operation on March 1, because the records show an increase of 7·84 per cent. in the consumption of gas in the daytime, as contrasted with a decrease of 9·6 per cent. in the consumption between 4 p.m. and 8 a.m. In addition to illustrating the result of the restricted lighting on the consumption, these figures possess another significance pointed out by the Superintendent (Mr. F. A. Price). That is to say, they indicate a gratifying increase in the numbers of gas-consuming appliances in use. The books prove that at the end of last year there were practically 12,000 more cookers, grillers, and fires fitted than was the case at the close of 1914. This goes a long way towards off-setting the temporary restriction of the public lighting consumption. Labour has to be used sparingly at Manchester as elsewhere, and while the prepayment meters are attended to as frequently as possible, so as to release the coppers for circulation, a great saving has been brought about by reading the ordinary dry meters only once a quarter, instead of twice, as in normal times. Wet meters, however, as far as possible continue to be inspected twice a quarter.

Board of Trade and Gas-Lighted Trains.

The electrical interests, according to custom, are continuing to do their utmost to keep alive the question of supplanting gas lighting by electric lighting in trains, while defending the use of electricity in mines and other places, despite the heavy list of fatalities due to such use that has been produced the last few years. A question has been asked in the House of Commons as to what the Railway Companies are doing in the matter of conversion from one system of lighting to the other, in view of the recommendations of the Board of Trade Inspectors; and Mr. Runciman could only answer that the Railway Companies are effecting conversions on their long-distance express trains as and when opportunity allows. The position is one that is very unsatisfactory. The clamour over the matter is distinctly due to the initiation of interested parties, who have taken advantage of the recommendations of Board of Trade Inspectors, whose opinions have been formed on extremely doubtful evidence advanced by men who have "thought" or "believed" something or other on alleged observation at the time of the accidents. The "observations" made during the minutes following the shock, and during the height of the commotion and horror succeeding all such events when of a serious nature, cannot be of a very exact order, and therefore are suspect. The incandescent embers from the engines have been fanned into flame—and by some excited individuals into a gas-flame. These gas-flames have been seen burning as jets where gas could not have been owing to the severance of the connections at the cylinders. Gas too has been seen burning in other places, though cylinders have ugly openings in them through which the high-pressure gas would rush and be dissipated without doing harm. But with it all, it does not appear to have occurred to the Inspectors or to the technical advisers of the Board of Trade that some inde-

pendent and competent persons of scientific standing, should be called in to thoroughly investigate what would happen in such cases—whether or not the gas under the conditions would be an active agent in connection with the conflagration. If this were done, we have confidence as to the result. Until it is done, the Board of Trade are not going to the extent they should do before bringing pressure to bear upon the Railway Companies as to incurring the heavy expense of changing from one system of lighting to another, and the heavy cost of lighting trains electrically, and before depriving the public of a reliable and good quality light, which is less injurious to vision than the light which prejudice and interest urge should supersede it.

Coal and Coke Exports.

The effect of the work of the Coal Exports Committee is markedly illustrated by the Board of Trade returns for December. Notwithstanding that France was a buyer of 1,386,299 tons of coal, compared with 1,246,786 tons in December, 1914, and 1,099,553 tons in December, 1913, the total quantity of coal exported during the month was 3,287,242 tons, or a reduction of 411,632 tons on December, 1914, though the quantity that left our shores last month was 57,789 tons more than in December, 1913, when Russia, Germany, Belgium, Austria-Hungary, Greece, Roumania, and Turkey were purchasers. Against them all are blanks for the past month. Several of the other countries, however, who were heavy buyers in December, 1914, show considerable reductions for last month—notable ones being Sweden, which is 120,000 tons down, and Italy, which is nearly 400,000 tons down. The amount of coke exported during the month was 101,168 tons; while in December, 1914, it was 107,442 tons, and in December, 1913, 118,619 tons. With the close of the year, it is interesting to bring into comparison the exports of coal, coke, and manufactured fuel the last four years. In 1912, the quantity of coal exported was 64,444,395 tons; in 1913, 73,400,118 tons; 1914, 59,039,880 tons; 1915, 43,534,771 tons. Therefore in comparison with 1913, the war year of 1915 exhibits a decline of 29,865,347 tons. The figures for coke are: 1912, 1,010,650 tons; 1913, 1,235,141 tons; 1914, 1,182,848 tons; 1915, 1,010,302 tons. For manufactured fuel, the figures are: 1912, 1,580,803 tons; 1913, 2,053,187 tons; 1914, 1,607,757 tons; 1915, 1,225,071 tons. Last year, France took approximately 5 million tons of coal more than in 1913.

Gas Heating of Bakers' Ovens.

The Central Gas Publicity Bureau of Berlin reports that a difficulty which, it states, has hitherto existed in the heating of bakers' ovens of the type heated by an internal fire or burner—due to the fact that the Méker burner, which has heretofore been generally used for heating them, requires a gas pressure of at least 18-10ths—has now been overcome. This statement is based on a report from Herr Kobbert, the Manager of the Königsberg Gas-Works, to the effect that Launhardt's gas-burner for bakers' ovens heats them perfectly at less than 4-10ths pressure. This result is, of course, only attained if the gas service and connection to the burner are sufficiently large. The burner shows much less tendency than earlier burners to light-back. The adoption of this burner in bakers' ovens in Königsberg has been one factor contributing to the increase in gas consumption there, which in the months of August, September, and October last was 76 per cent. greater than in the corresponding period of 1913.

Sulphate of Ammonia in Japan.—Gas companies in Japan have, according to the "Journal of the Imperial Gas Association," been awakened to the unwise methods hitherto adopted for disposing of gas liquor; and some of them are now preparing to undertake the manufacture of sulphate of ammonia. Among others installing plant are the Western Consolidated Gas Company, the Nagasaki Electric and Gas Company, and the Sendai Gas Company.

Society of Chemical Industry and the Pollution of the Atmosphere.—At a meeting of the Society of Chemical Industry held at the Grand Hotel, Manchester, last Friday, Professor Haldane Gee alluded to the subject of impurities in the Manchester atmosphere. He showed that the atmosphere, in regard to smoke, had been very much the same as at present for the past forty or fifty years. He compared Manchester with a number of other towns with respect to sunshine; and from this it appeared that Manchester had the lowest amount. Mr. R. H. Clayton (of Messrs. Hardman and Holden, Limited), who took part in the discussion, suggested that Manchester should have a municipal central hall, where, with a view to diminishing the smoke nuisance, the best apparatus for gas and coal heating could be exhibited, and also where examples of the effects of smoke on buildings, &c., could be shown.

PROJECTED GAS LEGISLATION FOR 1916 BY BILLS AND PROVISIONAL ORDERS.

[Third Article.]

This week we complete the review of the Gas Bills, and give notices of the two Gas Provisional Orders which have been lodged with the Board of Trade.

The Plymouth and Stonehouse Gas Company's Bill is one of the most interesting of the session. In the preamble it is submitted that the Company have for some years past carried on a considerable business in connection with the manufacture, utilization, and conversion of products arising in the manufacture of gas. Certain products arising in, or resulting from, the manufacture of gas and the distillation of tar are required in large quantities in connection with the prosecution of the present war; and the Company have, under the provisions of the "Munitions of War Act 1915," and at the instance, and with the approval, of the Minister of Munitions, taken steps to increase the output of such products, and with this object to acquire certain works and plant for the distillation of tar, and to provide other works and appliances. The Company have entered into an agreement for the acquisition of certain tar-distilling works in the county borough, and the business carried on in connection therewith now vested in the executors of Thomas Henry Harvey deceased. It is therefore expedient that additional powers should be conferred upon the Company with reference to the manufacture, utilization, and conversion of products arising from the manufacture of gas and the distillation of tar, and that provision should be made for the purchase by the Company of tar and other residual products from companies, local authorities, bodies, and persons supplying gas or producing tar within the counties of Devon and Cornwall, and also for the purchase by the Company of such products other than tar from other companies, local authorities, bodies, and persons. It is also expedient that provision should be made under which the business of manufacturing, utilizing, and converting such products may be carried on by the Company in co-operation with other companies, local authorities, bodies, or persons supplying gas or producing tar within the counties of Devon and Cornwall. Information is then given as to the capital of the Company, which now consists of 7000 shares of £10 each, bearing dividend at the rate of 7½ per cent. per annum; 3000 shares of £10 each, bearing dividend at the rate of 7 per cent. per annum; £188,120 ordinary stock, bearing dividend at the rate of 5 per cent. per annum. The Company have received by way of premiums on the sale of shares and stock £76,550; and they are authorized to raise a further sum of £75,330 by the creation and issue of ordinary stock. Under their Acts, the Company are empowered to borrow £123,333, of which they have already raised £69,347 by the issue of £50,000 of 3 per cent. debenture stock, on the sale of which no premium was obtained, and £20,000 of 3½ per cent. debenture stock, which realized on the sale £19,347. The Company have expended on capital account £447,952. The increasing demands for gas will necessitate further capital expenditure; and it is submitted that it is expedient that the Company should be authorized to issue debenture stock to the executors of the late Mr. Harvey as consideration, or part consideration, for the property acquired, or to be acquired, by the Company, and that for these and other purposes additional powers should be conferred with reference to the creation and issue of debenture stock. The first clauses of the Bill are to empower the acquisition of the land, works and plant, and business of Mr. Harvey, and to authorize the carrying on of the work of converting residual products, &c., in accordance with the proposal sketched in the preamble of the Bill. The Company also ask to supersede their illuminating power standard by a calorific value one of a level 500 B.Th.U., tested by the instruments and under the conditions prescribed by the Metropolitan Gas Referees. Power to the Board of Trade to make a triennial revision of the standard is arranged for; authorization to move in the matter being conferred on the Company, the Corporation, or the Plympton St. Mary Rural District Council. A large number of clauses common to all modern Gas Bills are included. Then there is the one to sanction the issue of debenture stock as consideration for the acquisition of the property from the executors of Mr. Harvey. The Company, however, propose that they shall be empowered to create debenture stock, including premiums and the consideration referred to, to the amount of £30,000. Finally, they desire to create and issue as redeemable debenture stock any debenture stock authorized by this Act or any unissued debenture stock authorized by their Acts of 1898 and 1903. They ask, too, for power to specify, in the resolution determining the issue as redeemable stock, the terms and conditions on which the stock shall be redeemed. Provision is made for the formation of a redemption fund. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The general lines of the Bill promoted by the South Metropolitan Gas Company were noticed in our issue for Dec. 28 (p. 712). It is wholly a financial measure, and has for its object the setting of the Company's house in order to conform with the times, in respect of capital powers. In the first place, it is declared that the capital of the Company consists of £6,609,825 of stock, and the loan capital of £1,895,445 of 3 per cent. debenture stock. The repeal of all unexercised powers of issuing capital and debenture stock is sought; and this is followed by a desire for authorization

to the raising of £1,000,000 by the creation and issue of ordinary stock or preference stock, or wholly or partially by one or more of these modes respectively. The power to borrow on mortgage is placed at one-third part of the additional capital. Following the clause to confer power to create and issue debenture stock, are provisions as to the mode of issuing stock, which were sufficiently described on Dec. 28. The Directors also require authority to issue as redeemable preference stock any portion of the capital which the Company are or may be authorized to raise as preference stock, and as redeemable debenture stock any money authorized to be raised as debenture stock. Authority is taken to provide funds for redemption purposes. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Uxbridge Gas Company are promoting a Bill for the transfer to them of the undertaking of the Eton Gas Company, to extend the limits of supply, and for other purposes. The issued capital of the promoting Company consists of £147,925 of consolidated stock, entitled to a dividend of 5 per cent. per annum, subject to increase or decrease under the sliding-scale. They have also borrowed £3000 on mortgage, have created and issued 4 per cent. debenture stock to the nominal amount of £33,875, and have received in respect of this debenture stock £32,401. The price now charged for gas is 3s. 8d. per 1000 cubic feet. The issued capital of the Eton Gas Company consists of £5250, divided into 350 "A" shares of £15 each, entitled to a maximum dividend of 10 per cent. per annum; £4750, divided into 316⅔ "B" shares of £15 each, entitled to a maximum dividend of 7 per cent. The Eton Company have also created and issued redeemable debenture stock to the amount of £1700, bearing interest at the rate of 4 per cent. per annum, but have not borrowed any sums on mortgage. The Eton Company are authorized to charge a maximum price of 7s. per 1000 cubic feet; and the price now charged by them is 4s. 3d. per 1000. The terms of transfer have been agreed to. The lands of which the Eton Company are in possession are reputed to be subject to certain Lammas or other commonable rights exercisable by inhabitants and tenants of the manor of Eton-cum-Stockdales and Colenorton, which rights might interfere with the utilization of the lands by the Uxbridge Company for the storage of gas, as authorized by this Act. The Company therefore suggest the expediency of being authorized to purchase and acquire all such existing rights in respect of the lands in question. The clauses provide for the extension of the limits of supply to include the urban district of Eton and certain specified parishes, within which added limits the Company ask to be allowed to charge 6d. per 1000 cubic feet in excess of the price of gas supplied within their limits as at present existing; but this excess charge is not to be taken into account in calculating the rate of dividend. Powers are sought to lay a connecting-main, and to use a piece of land at Eton Wick for gas storage purposes. As soon as is reasonably practicable after the date of transfer, the Company are to issue to the holders of ordinary and preference shares in the Eton Company preference stock in the Uxbridge Company as follows: To each holder of Eton "A" shares, £30 of preference stock for each share held by him, to each holder of "B" shares £21 of preference stock for each share—the stock to carry a dividend of 5 per cent. Authorization for the creation of the necessary amount of preference stock is sought. Provision is also made for the payment of a dividend on the Eton shares up to June 30 next. Each of the Directors of the Eton Company is to receive £210 by way of compensation for loss of office. Borrowing powers are desired up to one-third part of the issued capital; and section 17 [Limit of Interest on Money Borrowed] of the Uxbridge Order of 1914 is to be repealed. The Treasury capital-raising restriction clause has appended to it this provision: "Provided that nothing in this section shall be deemed to restrict the creation and issue of preference stock to proprietors of shares of the Eton Company in pursuance of the section of this Act of which the marginal note is 'Creation of Stock for Purposes of Transfer.'" Among miscellaneous provisions is one providing for differential prices, but protecting consumers against preferential ones under similar circumstances. [*Parliamentary Agents: Messrs. Lees and Co.*]

PROVISIONAL GAS ORDERS.

The Provisional Order which the Fleetwood Gas Company have lodged with the Board of Trade has a main purpose, and that is to alter sections 27 and 28 of the Company's Act of 1912, so that they shall be read and have effect as if the words "not exceeding the rate of four pounds per cent. per annum" were omitted therefrom; but, except with the consent of the Board of Trade, it is proposed that no higher rate of interest than five pounds ten shillings per cent. per annum shall be paid by the Company in respect of any money borrowed by them. Another clause relieves the Company from any obligation to give from any main a supply of gas for any purpose other than for lighting or domestic use in any case where the capacity of the main is insufficient for such purpose, or if, and so long as, any such supply would, in the opinion of the Company, interfere with the sufficiency of the gas required to be supplied by means of such main for lighting purposes. The only other clause worth notice is one which empowers the Company to levy and recover such charges as they think fit for taking the reading of any meter fixed in a house which is either in whole or in part let furnished, at the request, and for the convenience, of consumers, at times other than the Company's periodical readings. The charge for a special reading is not to exceed 6d. [*Parliamentary Agents: Messrs. Torr, Durnford, and Co.*]

The Long Eaton Gas Company have deposited an Order for a single purpose. It is to give them power to construct new works on lands scheduled—the land in question comprising 680 square yards, bounded north and east by other lands of the Company. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

ELECTRICITY SUPPLY MEMORANDA.

That Naughty Pick.

It is a matter of common observation that very minor happenings have often very large results in connection with electricity supply undertakings. Quite a small mishap at a generating-station may cause a considerable amount of damage by fire—as witness a long roll of occurrences—or may cut-off or disorganize supply for hours and perhaps days. A fusion in the distribution system may cause the generation from the insulation of quite a large quantity of highly explosive and poisonous gases, and do considerable damage to neighbouring premises by explosion, or to the inmates by suffocation. A pick driven into a cable in the district may do untold mischief. A pick hole in one of the distributing mains, the Electrical Engineer reports, was one of the major faults causing the recent large breakdown of the electricity supply at Finchley. The pick did its work with unerring thoroughness. We do not compliment it upon the results of its work, which were altogether out of proportion to the act. There was partial damage to the large generating set at the station. All the three main areas of supply were also affected; and there were numerous minor faults on consumers' premises. The Engineer is of opinion that street openings should be under supervision, as similar damage has been accomplished on several occasions; but as there has not been complete disorganization of the supply since 1903, it is clear the particular pick that made the disastrous hole on this occasion deserves exceptional censure.

Notice of Openings.

About the question of supervision, the "Electrician" does not seem to be particularly well informed on the law relating to the making of excavations by statutory undertakings. It says that the procedure often followed at the present day appears to be for anybody with the necessary powers to break up the streets without consultation with those who have similar interests, with the result that an unfortunate stroke of a pick may cause a breakdown in the mains, as was the case at Finchley, and as was also the case lately in respect of water-mains at Brighton. Our contemporary also believes that in some undertakings it is the practice for notice to be given of excavations; and it looks upon this as a commonsense and businesslike method. The sections of the Gas-Works Clauses Act, 1847, regarding the opening of roads were incorporated in the Electric Lighting Act of 1882; and under section 8 of the 1847 Act, it is provided that three clear days' notice shall be given to the road-controlling authority before making openings. As a rule, in Special Acts the three days' notice is extended to a longer period. It so happens that the greater number of electric undertakings are owned by the local authority who are also the road authority; so that they have always information in advance of openings to be made by those with statutory right to occupy the subsoil of the roads. The Finchley Borough Council must have had notice of the particular road opening in which the pick made its onslaught on the electric cable; and it was quite open to them, if thought necessary, to have supervision over the breaking-up of the road on that occasion. The electrical papers do not inform us as to which undertaking was the transgressor in this matter; perhaps the culprit was a workman of the electrical undertaking itself. In its comment, the "Electrician" only speaks of electricity and water undertakings as occupants of the subsoil of roads, but probably in its remarks gas supply comes under a reference to "any of the public services." However, our point here is that electricity-owning local authorities are in a specially good position to know all about what other statutorily authorized road openers are doing—more so than are the latter of what the electricity undertaking are proposing.

Electrocuted.

The inquest has been held on the two good-natured fellows who at Eastbourne, on the day following Christmas Day, went to the rescue of the occupants of a motor car which had collided with an electric pillar switch-box, and who lost their lives in consequence. Their names are Ebenezer Shadwell, a coal merchant's carman, and Private Thomas Marshall, of the Royal Army Medical Corps. It was a novel occurrence; but the pity of it is that there is not any great likelihood of profit in the way of future protection coming out of the lamentable mishap, unless the Board of Trade insist on above ground pillar switch-boxes being placed out of the way of all possibility of accident through collisions in these days of fast-moving traffic. Mr. A. P. Trotter, the Electrical Adviser of the Board of Trade, was present at the inquest; but whether he secured any useful lessons from the sad event cannot be said. All that the Jury could find to append to their verdict was that such pillar switch-boxes should be placed further from the side of the footpaths. The Corporation Electrical Engineer explained that he preferred the above ground pillar

switch-box because it was dangerous for the men to handle live wires in underground boxes. The chauffeur of the motor-car which did the damage could not account for the accident in any way. Just at the point, he said, the car seemed to swerve, and there was nothing whatever to account for it. There was suggestion that perhaps some magnetic influence came into play; but, of course, no one can give credence to any such idea. However, the box was broken, and three high-tension cables were exposed and torn away. The deaths of the two men are not, under such circumstances, difficult to account for.

An Electrified Kitchen at Euston.

The electrical papers are filled with pride. Perhaps the largest single electric cooking installation in the country is now to be found at Euston, in connection with the new dining-room opened there by the London and North-Western Railway Company. The equipment has been supplied by the Brompton and Kensington Accessories Company. We have not had an opportunity of making an inspection, and so can only explain the components of the installation from what has appeared in the electrical papers—taking as our guide and friend the "Electrical Review." Our readers will see that the installation is a very substantial one; and it is also one that is likely to be very costly in running, judging from the confessions of electrical engineers and other experimental users of electric cooking appliances, of which experiences the London and North-Western Railway Company have probably been kept utterly in the dark. However, they have commenced to accumulate experiences of their own; and we undertake to say that an electrical expert will be keeping a constant supervising eye and hand upon this plant for many a day to come. The installation is in a basement kitchen and servery and grill adjoining the dining-room. The kitchen equipment consists of four ovens, each measuring internally 2 ft. by 2 ft. by 2 ft. 6 in. high, with the heating elements around the sides and back. Seven different heats are provided. Above the ovens is a hot closet, with a maximum loading of 3 KW. The total loading of the oven range is 23 KW. Adjoining are two ham-boilers, each of 30 gallons capacity. Together these have a loading of 7·5 KW., and adjoining this apparatus is a double grill for kitchen use, both appliances being provided with heat regulation, and the latter with 7 KW. loading. Fuses and pilot lights are plentifully scattered about the installation. In the centre of the kitchen is a large boiling-table equipped with 23 hotplates of from 2000 to 1200 watts maximum loading, giving a total loading of 38·6 KW. Each plate is provided with a three-heat regulation switch. A bain-marie, arranged in two sections with 1500 watts, maximum loading, a hot closet for 1000 plates with two-heat regulation and a loading of 3·7 KW., and a vegetable steamer with six nests, and a 4·5-KW. loading with three-heat regulation, are also installed; while adjacent to the service lifts in the entrance, which communicate with the servery above, is a small hot closet, of 2·3-KW. loading, for keeping food warm while it is *en route* to the servery. In the servery, there is a vegetable server with a 4·2-KW. loading and two heats to each compartment. Two soup tureens, kept hot by means of water-baths, are also fitted; the heat regulation being under control by six push-and-pull switches. The servery also contains a large carving-table with five cutting dishes for joints and other sundries. An electrically heated shelf behind enables plates and food to be kept hot while waiting delivery; and hot cupboards are also provided below the table for keeping food warm. The total loading of this apparatus is 10 KW. The electric grill is clearly visible from the dining-room. It has two grilling compartments, with hot closets both above and below, and has a 12·5 KW. loading. The switches in this case are of the push-and-pull type. It has always been proclaimed that there are no fumes and no hot air to dispose of with electric cooking; but here fresh air is introduced and used air exhausted through special shafts. Each piece of apparatus is on a separate fused circuit and each circuit is led through a meter with a view to obtaining complete cost records.

Thin Criticism.

A peculiarly ineffective comment has been made by "Electrical Industries" upon the paper that Mr. W. A. Tookey recently read before the Institution of Junior Engineers on the "Modernization of Power Plant in Factories." [See "JOURNAL" for Dec. 28, pp. 699, 705.] Our contemporary is generally in unhappy case when it touches on the power question; for it is given to quibbling over terms and phrases. But it never by chance devotes itself to demonstrating, by figures and other data, that those are wrong who are deemed worthy of its weakly criticism in this connection. We see that Mr. Tookey "harped" on the "alleged" greater economy of the gas-engine as compared with the electric-motor. But we fail to see that his allegation has in any way been undermined by the writer in "Electrical Industries." Mr. Tookey is a man not only of figures and theoretical computations, but of large practical experience with power agents—an experience that it is evident cannot be claimed by his critic. As a sample of the absurdity of the criticism, it is pointed out that Mr. Tookey gave a table which shows that, according to the age of an engine, as indicated by the differences in compression, the gas consumption will vary from about 35 to 18 cubic feet per brake-horse-power-hour. Then we come to the gem of the criticism. It is remarked that these wide limits having been admitted, "Mr. Tookey then commenced to compare the cost of gas-engine and electric-motor operation by 'assuming' that the average engine demands only 19 cubic feet of gas per brake-horse-power-hour for its successful operation." The critic seems to think there is something wrong in the adoption of 19 cubic feet; seeing that the consumption may vary between 35 and 18 cubic feet. But why he thinks this, he does not explain. Let us remind him that Mr. Tookey was dealing with the "modernization" of power plant in factories; and in modernizing his power plant, an owner would take the modern engine with modern compression, and get the best possible efficiency. Mr. Tookey was really erring on the side of liberality in taking an average of 19 cubic feet of gas. But the critic—purblind critic!—apparently fails to understand why, in constructing a case, it is always safer to be generous against oneself than throw open oneself to criticism by extreme claim. However, because Mr. Tookey took 19 cubic feet per brake-horse-power-hour, the critic opines that the comparisons he makes are far too suggestive of special pleading to be taken seriously. There is genuine short-sightedness about the critic. Mr. Tookey made a special point of the higher initial cost of a gas-engine than of an electric-motor; and we think he might have made a note of capital cost in relation to work capacity, as illustrated by Mr. H. C. Widlake in connection with a laundry illustration, of which "Electrical Industries" really fights shy. [See "JOURNAL," June 22, p. 695, and this week.] Again, the critic complains that oil, water, and attendance, are not immediately referred to as exercising a "profoundly" qualifying influence on the comparisons given in regard to cost. The critic has to admit that Mr. Tookey was not negligent of any of these matters; but he seems to think that the manner of treatment did not give the sum-total of costs in a truly comparative way. Mr. Tookey's paper was prepared for men of intelligence, with engineering knowledge. However, the critic suggests that the advantages of the electric-motor are prompting smaller factory owners gleefully "to scrap their gas-engines in favour of the far more economical electric-motor." He does not show by definite method where the greater economy of the electric-motor comes in; Mr. Tookey did illustrate the greater economy of the modern gas-engine. Further the critic does not tell us how it is the makers of gas-engines have had to increase the size of their establishments, nor how it is that gas undertakings are doing remarkably well with their power loads—many of them better than ever before.

Living Wages and the Man.

At intervals, there is complaint as to the exiguous salaries paid to those who are in immediate charge of electricity generating stations. The trained technical assistants chafe under the injustice, as do the technical assistants in some other industries of which there is intimate knowledge. The matter is again raised in the "Electrical Review" by a writer, signing himself "Chief Assistant." Electricity stations, like gas undertakings, have suffered a drain upon their men; and some of the knowing assistants have left stations where the remuneration is poor to take positions where the emoluments are of a more attractive order—perhaps made so in some cases through the pinch that exists for properly qualified and capable men. According to the correspondent of the "Review," in many cases there has been an attempt to stem the tide of affairs by offering paltry war bonuses and an enamelled badge, as compensation for the extra cost of living, and possibly to imbue the men with the importance of their position to the community. Lately, however, there has been increasing difficulty in getting suitable men as charge engineers and switchboard attendants. The practice is, however, growing (and it is described as a "reprehensible" one) of promoting untrained switchboard attendants to positions of charge engineers, no doubt with a view to economizing on salaries, which are often on a level with the wages paid to an engine-driver or greaser. The results, it is stated, are very apt to be reflected in the shape of increased generating costs, particularly on the steam side of the plant. We are afraid that much the same thing can be said in regard to some—fortunately not all—gas undertakings under the control of local authorities. The penny-wise-and-pound-foolish policy of certain local administrations is notorious. They will offer an ordinary workman's wage to technically trained men, upon whose advice weighty financial issues very often depend; and, on the other hand, they will spend money lavishly in the provision of something that is more or less a luxury—such as in providing electrical equipment for a workhouse. The characteristics of local government are very singular. However, "Chief Assistant" complains that the Institution of Electrical Engineers has never evinced a genuine interest in electrical stations or their engineers. Not long since, the complaint was made that the Institution of Gas Engineers did nothing whatever to protect the status and conditions of members of the gas profession who are in municipal service. There is no consolation in this unanimity. It simply exemplifies that degeneracy, or inability to appreciate the necessities of the times, on the part of some of our local governing bodies, is a growing defect, and that the technical bodies of two great industries do not live up to their opportunities, or are incompetent to take the initiative in a matter of considerable and pressing importance to a not negligible part of their membership.

Mr. and Mrs. James Lee, of Eccleshill, near Bradford, celebrated their Golden Wedding anniversary recently. Mr. Lee was for about 36 years Manager of the Eccleshill Gas-Works, retiring in 1902, when he was presented with a handsome writing desk by his employers.

PERSONAL.

The appointment is announced of Mr. A. M'D. DUCKHAM as Deputy Director-General of Munitions Supply. Mr. Duckham was for some time at the Munitions Invention Department.

Mr. A. P. KELSEY, one of the country representatives of Messrs. Falk, Stadelmann, and Co., Limited, who is well known among gas managers in the South-West of England, has joined the Royal Flying Corps.

Mr. G. H. ELLIOTT, of the Exmouth Gas Company, has obtained the appointment of Superintendent at the Flathouse works of the Portsea Island Gaslight Company. Previous to going to Exmouth, Mr. Elliott was with the Nuneaton Gas Company, and also at the Hull station of the British Gaslight Company, under Mr. John Young.

Professor W. H. PERKIN, F.R.S., Professor of Chemistry at the University of Oxford, has accepted the post of head of the Research Department of British Dyes, Limited. He has also accepted the chairmanship of the Advisory Council of the Company, in place of the late Professor Raphael Meldola, F.R.S. Professor Perkin is the eldest son of the late Sir William Perkin, the founder of the coal-tar colour industry. From 1887 to 1892 he was Professor of Chemistry at the Heriot-Watt College, Edinburgh; and he held a similar post at Victoria University, Manchester, from 1892 to 1912.

We are gratified to see, among those to whom the Military Cross has been awarded for service in the field, the name of Second-Lieutenant CLIVE GRIFFIN, R.A. (T.F.), only son of Mr. William Griffin, the Secretary and General Manager of the Folkestone Gas and Coke Company. He is one of five cousins, all living in Folkestone, who are serving in the army. Lieutenant GEOFFREY V. STRINGER, North Midland Brigade, who has also been awarded the Military Cross, is a son of Mr. E. H. Stringer, of Oakfield, Wolverhampton; the family being closely associated with the iron trade in the Midlands. Lieutenant Stringer volunteered for foreign service on the outbreak of war, and went to France in March. He was identified with the engagements at Neuve Chapelle and Ypres.

OBITUARY.

The death of Mr. JOHN FYFE, the Managing Director of Young's Paraffin Light and Mineral Oil Company, Limited, recently occurred at Kelvinside, Glasgow, at the age of 80.

Among the killed, in the casualty list of the Expeditionary Force dated the 2nd inst., appeared the name of Lieutenant N. AYRIS, of the Royal Engineers, grandson of Mr. John Ayris, M.Inst.C.E., formerly the Engineer to the Great Yarmouth Water-Works Company.

The death occurred, last Tuesday, at his residence at Springfield House, Cliffe Lane, Baildon, Yorkshire, of Mr. JOHN ROBSON. Deceased, who was 73 years of age, was a native of Colne, and was the founder of the firm of J. Robson (Shipley), Limited, gas-engine makers. He retired six years ago.

Mr. WILLIAM J. DOWSE, whose death took place last week, was Manager of the Bradford Corporation gas-works at Valley Road, Manningham. Mr. Dowse was highly respected by all sections of his staff, and by a wide circle of business and private friends. At the funeral there was a large gathering, which included Mr. Charles Wood, the Bradford Corporation Gas Engineer.

Mr. T. M. BARRON, who recently died at Darlington at the age of 63, was for a great number of years a well-known figure in the public life of the town. For several years he was Chairman of the Gas Committee, which under his presidency brought the works to a successful state second to none in the North. Besides a thorough knowledge of the lighting requirements of the town, Mr. Barron was possessed of a remarkable technical knowledge of gas manufacture; and he imparted into his duties something more than a layman's oversight. He was always highly respected by all the officials.

Yorkshire Junior Gas Association.—A meeting of the Association will be held next Saturday afternoon, in the lecture-room of the Bradford Gas Department show-rooms, Darley Street, when Mr. J. Demain, of Garforth, will deliver his Presidential Address, to be followed by a discussion.

Production of Artificial Fertilizers in Germany.—According to the "Engineer" newspaper, Herr Alfred Lohmann, the Chairman of the Chamber of Commerce of Bremen, stated at a meeting on the 28th ult. that the numerous new electric nitrate works in Germany had succeeded in producing not only all the saltpetre required for the manufacture of explosives, but would be able to supply during the coming spring all the artificial fertilizers required for agricultural purposes. As Germany previously imported over half the total Chilean production of natural nitrates, this is a remarkable achievement for the German electrical industry if it is actually the truth. Herr Lohmann even suggested that Germany would shortly be able to export artificial nitrates; but in view of the comparatively high cost of electric power in Germany, the price would exclude any competition with Chilean nitrate or even with the Norwegian products.

GAS AND FUEL LEGISLATION IN FRANCE.

PERUSAL of the pages of our contemporary, the "Journal des Usines à Gaz," shows that the natural and inevitable difficulties of the present time, which our French *confrères* have invariably met in a spirit of patriotic resourcefulness, are likely to receive nothing in the shape of amelioration, but rather the reverse, from a mass of proposed legislation of one kind or another, but generally of the arbitrary bureaucratic genus which fails to grasp the realities calling to be dealt with. Drastic artificial measures can never succeed in remedying, even temporarily, a state of things which springs from deep-seated natural causes, and may often intensify the disturbance which they seek to remove. Hence the feelings, not too strongly described as dismay, with which the French gas and coke industry has witnessed the measures suggested for the adjustment of conditions which, from the nature of the exceptional national circumstances, call for infinitely greater statesmanship than in times of peace.

After a discussion extending over several sittings, the Chamber of Deputies early in December last passed a Bill for the fixing of the prices of commodities, including those for heating and lighting. According to this, prices in a given town may be fixed by the mayor or, if circumstances so direct, by the prefect [of police], with the assistance of an advisory committee drawn from the chambers of commerce and agricultural syndicates. Infringements of the ruling of one or the other of these newly-empowered authorities are punishable by fines or imprisonment, while the goods which are the subject of the infringement may be requisitioned by the authorities. In supplement to this sufficiently drastic measure, an amendment was adopted authorizing the compulsory production on the part of a merchant, of a declaration of his supplies, under penalties similar to those for infringement of the authorized prices.

The declared object of the Bill is to eliminate the rise in prices of (mainly) articles of food as the result of unscrupulous speculation. The question of the price of gas hardly figures at all in the verbatim report of the protracted, and often irrelevant, discussion in the Chamber which the "Journal des Usines à Gaz" prints as a supplement to its issue of Dec. 20. Indeed, in answer to the direct question whether the prefects would have the power to fix the price of gas or electric current below that of existing contracts, it was stated that this could not be done, for the obvious reason that a price fixed by contract was not subject to elevation at the hands of the speculator. Our contemporary, at the instance of the Société Technique, the Syndicat Professionnel, and the Comité Central des Cokes, has presumably gone to the expense of laying the full discussion of the Bill before its readers, mainly with the object of demonstrating the general lack of perception of the Chamber in its dealings with economic questions. It appends two leading articles from "Le Temps" severely criticizing, not the aims of the Bill, which admittedly are laudable, but the ineffectiveness and futility of its measures. They comment on the absence from the debate of any discussion of the cause which disturbs the balance of supply and demand, or of any recognition of the fact that the fixing of a retail price can only increase demand still further, and so tend to paralyze the enterprise of producers thus hardly hit. The appeal is made to the Government to recognize the national spirit of merchants and producers instead of treating them as suspects; also to examine more thoroughly, and with the object of relieving the national situation, the question of transport by rail and sea, and the better organization of the existing transport facilities.

While the foregoing Bill has been passed by the Chamber and merely awaits ratification or modification by the Senate, a further measure, of much more vital importance to the French gas industry, has been drafted by the Commission of Mines of the Chamber of Deputies. It embodies two previously drafted Bills, and seeks to regularize the distribution, sale, and price of fuel by the establishment of a central bureau for the control of all fuel for public and industrial use. According to this suggested measure, a central or national office shall have the power to requisition the whole supply of fuel by the creation of sub-bureaux in mining districts and at all ports. These sale bureaux will receive the requisitions from the central office, and carry out instructions as to the supply of other requirements. Railway companies and gas undertakings are to apply to the central office stating their needs. Any sale by home producers or importers, otherwise than through a sale-bureau, is declared invalid. The regulations apply also to metallurgical coke. Producers of gas coke are to observe the directions as regards priority of sale, which they are to receive from the central office. The Bill likewise seeks to extend its scope to the fixation of prices of coal of various grades from French mines as well as of coal imported from abroad. In the case of French or imported coal for domestic consumption, prices are to be fixed locally by the prefects in accordance with those at the mines or at ports of disembarkation, supplemented by sums equivalent to the cost of transport and to those of any local duties, and with regard to established customs of supply and delivery and to a normal commercial return. In the case of coal for purposes other than domestic, prices to be paid at the pit or port are to be fixed by an order of the Ministry of Public Works issued on the first and fifteenth of each month—such prices being calculated from the average figures for French and imported coal, but with additions to relieve the central office from the expenses incurred in maintaining

advantageous prices in certain departments or communes, while also open to reduction in respect to advantages secured by the office from its arrangements for metallurgical coke. The latter is to be acquired by the National Office at a price fixed by the rules applying to other requisitions. Its sale price will be fixed by the office so as to approximate to that of requisitioned French coke and imported cokes. Prices of gas coke will be fixed by fortnightly orders of the Ministry of Public Works as in the case of coal. Balances representing the differences between sale prices for domestic fuel and those granted to producers and importers will be paid to the latter in the month following delivery. An exception to these regulations applies to coal necessary for the requirements of the mining undertaking itself, or for consumption by mine employees or the public in mining districts. In these cases the sale price may not exceed that permitted to the producer. Infringements of the regulations are to be punishable by imprisonment from six days to six months, or by a fine of 500 frs. to 10,000 frs., or by both.

Against this piece of complex and artificial legislation, the Central Committee of French Collieries has made emphatic protest to the Ministry of Public Works. In affirming its desire to give its support to any measure in the public interest, it declares its firm conviction of the serious inconveniences which would follow from the proposals outlined above. While it regards as useful the establishment of a central bureau for the control of supplies as regards quantity and priority, on the other hand it views the assumption of powers for the movement and financial control of the whole supply of fuel, home or imported, as leading to disorder, grave financial risks, paralysis of existing facilities, and discouragement of those already actively engaged in the industry. While the Committee considers that the circumstances call for Government supervision of prices charged by the producers and importers—it had submitted its own suggestion six months previously, and believes that importers have decided to act along the same lines—yet it cannot help regarding a scheme of fixation of prices as dangerous, since under such a system it is impossible to provide against highly fluctuating factors such as freight and demurrage. While effective encouragement of municipal enterprise in ensuring local supplies of coal is undoubtedly to be welcomed, the compulsory assumption by 30,000 French municipalities of the monopoly in the acquisition, holding, and sale of domestic fuel impresses the Committee as a provision lacking in prudence.

The domestic consumption should be the subject of special supervision, in the form of an increased allowance from the suppliers of French coal at a low price in the shape of a reduction of the tariff on imported coal with its attendant pressure on less well-to-do households. Moreover, the Committee views with great disfavour the distinction drawn between the mining departments and those not of this character.

Finally, the Committee strongly protests that the coal problem is one only of transport. The only measures which will be really effective are those for the better utilization of rolling stock, unloading facilities at ports, and adjustment of freightage charges. While acknowledging the desire of the Government and the apparent logic of the proposals, the Committee urges that the measures which the situation demands are of a much less ambitious and more practical kind. It calls for energetic and persistent action by the Government.

That transport—or rather lack of it—lies at the root of the fuel question in France at the present time is further shown by a recent memorandum to its members by the French Professional Syndicate of the gas industry. The problem of supplies becomes daily more acute from this cause. Barges obtainable with the greatest difficulty even at alarming rates, ships delayed for days at ports before being able to discharge cargo, excessive demurrage and storage charges (the latter the result of shortage of waggons)—such is the situation which the Syndicate depicts in a strain of positive anxiety. A conference on the subject has been held with the Minister of Public Works, when the dangers of the situation were represented; and it is hoped that such measures as are possible in the present conditions will be promptly taken.

COAL MINING AND THE WAR.

Second Report of the Departmental Committee.

It may be remembered that, some considerable time ago, a Departmental Committee of seven members, with Sir Richard A. S. Redmayne, K.C.B. (Chief Inspector of Mines), as Chairman, was appointed to inquire into the conditions prevailing in the coal-mining industry, with a view to "promoting such organization of work and such co-operation between employers and workmen as, having regard to the large number of miners who are enlisting for naval and military service, will secure the necessary production of coal during the war." After hearing evidence and securing information as to the shortage of labour and consequent decrease in output, the Committee issued a report containing various suggestions, the nature of which will be found indicated in the "Journal" for June 15 last (p. 633). They have now supplemented it by a second report; being, of course, by this time in a position to show the effect of the war on the coal mining industry during the first twelve months of its continuance, and the results achieved by the remedial measures proposed in the earlier report.

In the event, it appears that the loss of output has not been so great as was anticipated might be the case, mainly owing, it is thought, to the effect of the measures taken to mitigate the falling-off due to depletion of labour. Without any counteracting steps, it was calculated that the loss in production would probably amount to 36 million tons, against which might have to be put a reduction in exports of 24 million tons. Actually, the loss of output (omitting consideration of a small number of pits from which no returns were received) in the first twelve months of war, as compared with the like pre-war period, was somewhat under 30 million tons, or about 11 per cent. The falling-off was spread unequally over the period; the average monthly rate of decrease being over 3 million tons for the first seven months, as against something less than 1¾ million tons in the succeeding five months. When looking at the figures, it must, however, be borne in mind that the reduction in output during the earlier part of the war period was chiefly due to lessened demand; whereas subsequently it was owing almost entirely to the shortage of labour. Taking another period, the first three months of the second year of war, and comparing it with the first three months of the war, it is seen that the output of August, September, and October, 1915, exceeded that of the same period of 1914 by over 1½ million tons, though there was a falling-off when compared with the like three months in 1913 of 7½ million tons.

In the opinion of the Committee, it is remarkable that the falling-off in output of late has not been greater, in view of the steady depletion of mining labour which has taken place. It is calculated that the number of enlistments over the first thirteen months of the war amounted to more than 250,000, or 22½ per cent.; and as the net loss of employees in the pits making returns was 160,510 persons, or practically 16 per cent., while the enlistments totalled 235,000, it is obvious that there had been a substantial influx of labour to the mines. The average number of persons on the books during the first year of the war was 11½ per cent. less than in the year before the war; the average number of persons employed below ground falling-off by 12·6 per cent.

The Committee are pleased to find themselves in a position to state that the absenteeism did not increase, but remained the same during the last few months as in the earlier period of the war—namely, 9·8 per cent., which compares with 10·5 per cent. for the like period of the pre-war months. It is their belief that the efforts of the miners' leaders in attempting to secure more regular attendance at work have not been without result; but in this connection the important facts to be borne in mind are that, taking the coal-getters and coal-putters only, the absenteeism is very much higher than the average just stated, and that, if there were no avoidable absenteeism, the output would be increased by from 13 to 14 million tons per annum. Absenteeism is lowest in Scotland, and highest in England. It is from the North Staffordshire and Yorkshire districts that complaints in this respect have chiefly been received. It is perhaps an understandable fact that the districts having the thinnest seams of coal, and where the coal is hardest to get, should show generally speaking the best results in the matter of regular attendance at work. In the first report, the Committee pointed out that it was specially desirable during the war that the employers should co-operate with the representatives of the workmen on questions likely to tead to friction or stoppage in the present unprecedented circumstances. Through the medium of the Mining Association and the Miners' Federation, owners and workmen in districts where hitherto little had been done in this direction were urged to reduce absenteeism and put a stop to friction. One suggestion was the keeping of careful returns as to absenteeism in respect of those days on which coal was being wound at the mine. In some instances, joint committees of the management and the men have been established to watch the rates of absenteeism, and to endeavour to bring about more regular attendance at work. Information which the Committee have received satisfies them that a good deal has been done in concentrating the work of getting coal in the easier places in the mines, and in postponing developments and renewals which would in the ordinary course have been proceeded with.

On the subject of transport, the Committee realize the great difficulties with which the railway management have had to contend; and they understand that these difficulties will be increased in the near future [the report is dated Dec. 10], by reason of military exigencies. Transport facilities are being very materially affected by lack of available locomotive power; and their information is that this state of affairs will become worse, as movements of troops and munitions increase. They have therefore considered how far relief could be obtained in the direction of reducing the amount of work requiring to be done by the available locomotive power; and they have been advised that considerable advantage would be secured by some system of pooling of traders' and railway waggons in different districts. It is recognized, however, "that the value of any such proposal would depend upon the simplicity and efficiency of the system of pooling that might be adopted, and also that it would be most desirable that the proposed system should, if possible, be adopted with the concurrence of the coalowners and other interested parties in different parts of the country." In these circumstances, they recommend the preparation of a scheme of pooling suitable for the different districts, and its consideration by those concerned; and they think that "the Government might consider, upon the situation thus disclosed, as to the advisability of legislation upon the question"—any such scheme to operate only during the period of the war. As to the shipping position, the Committee feel that they are not in a position to judge how far matters could be improved by

the exercise of control; but "they are informed that, without prejudice either to international considerations or to the other carrying trade of the country, ships might be compelled to trade between home and foreign ports in the interests of the coal industry." If there is any possibility of improvement in this direction, the Committee remark that the matter might very profitably be made the subject of expert inquiry; and they recommend that such an inquiry should take place.

The total output of coal from the pits (quarries are not here included) during the first year of war is put at 250,357,000 tons, which compares with 281,076,000 tons in the preceding twelve months. But as exports fell off by 29½ million tons, and the amount placed in foreign bunkers by over 6 million tons, there was left a balance for home use and the Admiralty of 188,965,000 tons, as compared with 183,849,000 tons. The Committee have reason to believe that the demand for coal is now no less than it was during the pre-war period; for though collieries have been held up for want of transport facilities, they have heard of no instance of a colliery standing idle for lack of orders.

In conclusion, the Committee intimate that they propose to conduct further inquiry into the question of the regulation of the supply and price of pit timber, and that they will later on report upon this matter.

METHODS OF ECONOMY.

It would be difficult to find a more fitting subject just now for purposes of practical demonstration than the prevention of waste; and this being so, one may fairly anticipate a successful run for an exhibition representing domestic economy which is being held during the present week under the auspices of the Institute of Hygiene, in connection with the anti-waste campaign. There are lectures and demonstrations on economical cooking and labour-saving methods; and other matters drawn attention to are well calculated to advance the cause of domestic saving. The housewife who visits the Society's premises at Nos. 33 and 34, Devonshire Street, W., while the exhibition remains open may therefore depend upon getting some useful "wrinkles."

It is impossible to state in detail here the nature of all these "wrinkles;" but it may be said that Miss Helen Edden and her staff are demonstrating the uses of the gas-cooker in a delightful "all-gas" kitchen which has been fitted up by the Gas Light and Coke Company. Perfect cleanliness is not only suggested, but achieved, by the green and white tiles which form a dado round the walls. These tiles are curved outwards at the bottom, so that there is no opportunity for the collection of dirt at the point where the floor and th walls meet. For the floor, too, wood blocks are used, which are easily cleaned and polished. Three different methods of water-heating have been installed, so that visitors, whatever their requirements may be, will be sure to see something in this direction to suit them; and something, of course, they must have, if they follow the lines of this model kitchen, and do away altogether with the coal-range. In a recess, tiled all over, is a Parkinson cooker, and at its side a "London" coke-boiler, suitable for a house where a lot of hot water is required. Then for a medium-sized house or flat there is a Potterton combined apparatus, with storage tank and boiler all in one. The third system is a Parkinson "Gacylette," for use where people do not wish to go to the expense of providing flow and return pipes, or where the existing circulating system is unsatisfactory. This apparatus consists of 3 gallons storage capacity, and of means for heating the water. If fitted over the sink, it will conveniently furnish the hot water required for washing up; and the bath-room can be served by a geyser.

Though not yet in position, it is intended eventually—the model kitchen is, of course, to be a permanent addition to the usefulness of the building—to fix over the cooker in the recess a plate hot-cupboard with a glass front and sliding doors, similar to one which has recently been installed in the New King's College for Women. Open bars are provided at the bottom, through which heat passes upwards, from the top of the cooker and the gas or coke boiler (as the case may be) at its side, into the closed-fronted cupboard, which thus becomes an efficient plate warmer. Frequently, in the case of kitchens from which the coal-range has been entirely removed, mistresses complain that there are no means by which the maidservants can warm the kitchen, when they desire to do so; and as a suggestion for meeting this point, there has been placed in the model kitchen a small Richmond "Surrey" condenser, which looks bright and does not consume much gas. Lighting is by a Sugg ventilating lamp; and there is, above the cooker recess, a flue outlet from the room.

Those on the look-out for novelties will have their attention taken by the "Utility" hot-plate. It is found that in the ordinary way there are many consumers who have only a gas-ring; and the object of the invention is to increase the usefulness of these handy appliances by rendering them available for various sorts of cooking. The "Utility" plate is on legs, and has a loose top where it comes over the burner; and the appliance makes a solid stand on which can be safely placed (say) a large frying pan or a fairly heavy saucepan. For boiling the contents of a vessel, the loose top in the centre of the plate is removed; and when the boiling stage is reached the vessel is pushed to one side (where there is sufficient heat to keep it boiling), and another utensil takes its place. So one can have three or four vessels boiling, with the consumption of one gas-ring. The plate is designed so that, while heat radiates to the screened corners, there is no interference with the passage of air needed for combustion. The "Utility" hot-plate (which it is understood is being brought out by one of the large gas companies) has every appearance of being a thoroughly practical addition to the appurtenances of the small kitchen. It is strongly designed on a well-thought-out principle, and is to be made in three sizes, from 14 in. by 12 in. to 18 in. by 12 in.

Other working apparatus now in the kitchen includes a Rodda's "Dreadnought" plate-washer, supplied with hot water from the gas-boiler, and fitted with gas-burners underneath for keeping the water heated when it is in the machine; a Keith's low-pressure iron; and a "Uno" coffee-roaster.

For the demonstrations by the Gas Light and Coke Company's staff a Wright gas-cooker is being used, and upstairs, for other purposes, there are installed Richmond "Bungalow," Fletcher "Carick," and Davis cookers, and a "Chef" muffin plate.

DIGEST OF PATENT CASES.

A useful section of the reports of patent, design, trade mark, and other cases (which are published from time to time as supplements to the "Official Journal" of the Patent Office) is the digest prepared at the end of the year of the cases that have been decided. Looking through the digest of patent cases reported in 1915, which has been compiled by Mr. Frank G. Underhay, M.A., Barrister-at-Law, it is seen that on the present occasion there are naturally cases to be noted for which the war is directly responsible—the status of an "alien enemy" having had to be determined in various aspects.

There was one case in which, after a patent had been ordered to be revoked, war broke out, and the owners of the patent (who were a German company carrying on business in Germany) appealed; and it was decided that they were entitled to have the appeal heard in the ordinary course, in spite of the fact that they were alien enemies. An action of a somewhat different kind was that in which two companies joined in an action for infringement of a patent, but it was held that the patent had not been infringed. Here it was the plaintiffs who appealed; and, owing to the outbreak of war, one of the appellants became an alien enemy. In these circumstances, the appeal was suspended till after the conclusion of the war.

Ambiguity in the wording of specifications is a pitfall carefully, to be avoided by the patentee, for there is the warning of Earl Loreburn that, "if he uses language which, when fairly read, is avoidably obscure or ambiguous, the patent is invalid, whether the defect be due to design, to carelessness, or to want of skill;" and that "the only safe way is for the patentee to do his best to be clear and intelligible." An application for a patent for the use of a known substance in a new way, resulted in its being held that "the use of an old and well-known substance by itself, without anything more, does not constitute an invention." In one instance, too, a specification was held to be misleading because it did not achieve the result claimed; and the combination of old contrivances, each performing its old function, and not creating a new contrivance or producing a new or better result, was held not to have subject-matter.

These are only a few of the decisions recorded which are of importance to inventors. Design and trade mark cases are also included in the digest.

"Stella" Gas-Fires.

For the new patent "Stella" gas-fires, a particular value for use in the sick room or study is urged by the makers—the Carron Company. This is that the fires are absolutely silent in operation; while another feature claimed for them, which is of equal importance whatever may be the situation in which they may be working, is that they possess exceptionally high efficiency. The radiants themselves are specially constructed and fitted, and the fire is formed with the object of ensuring that no products of combustion can possibly escape except by the flue. Designed on simple and graceful lines, and with all parts standardized, and therefore interchangeable, the patterns of the "Stella" fire which are shown in the firm's recently issued booklet will appeal to gas consumers; and no doubt the Carron Company will be equally successful with the other designs which are now in course of preparation. The finishes have been arranged to meet the demand of every taste and scheme of room decoration. That is to say, the fires can be had in armour bright, "Cymric" (a new Carron finish which resembles armour bright, but is rust proof), or in bronze or enamel. Added to the points named, the assurance is forthcoming that rigorous tests have failed to make the burners light-back; while the regulation is of the simplest character, inasmuch as, once set for "full" by the patent controller, any alteration necessary to change the power of the fire is made by the tap.

Among wills lately proved is that of Professor Vivian B. Lewes who left estate of the gross value of £13,353.

At last week's meeting of the Institution of Civil Engineers the election was reported, as associate members, of Mr. John L. Butler, of the Leighton Reservoir Works, Masham, Yorks, and of Mr. Adam Morgan, B.Sc., of the Belfast Water Department.

THE "T. R. SPRAYOIL" APPARATUS

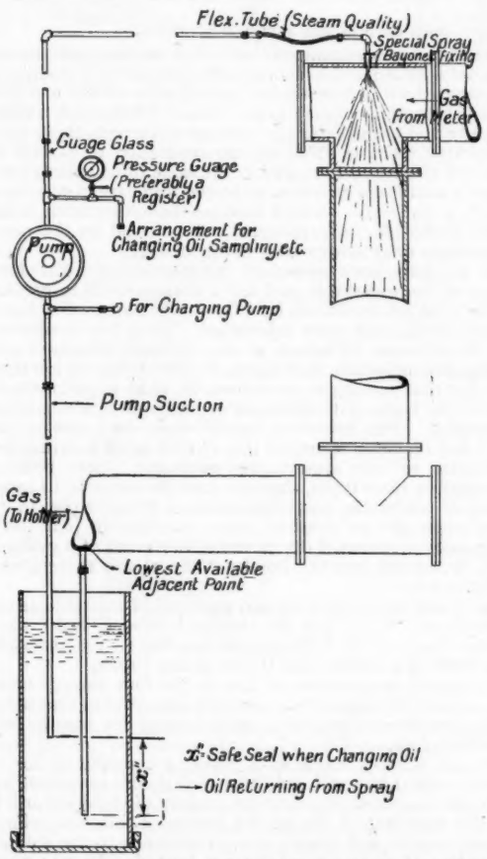
FOR THE PREVENTION OF NAPHTHALENE TROUBLES ON THE DISTRICT.

By WILLIAM THOMSON and R. H. RUTHVEN, of Ramsgate.

MUCH has been written on the subject of naphthalene troubles during the past few weeks; but we trust that a short description of how the question has been dealt with at Ramsgate may prove of assistance to anyone who is still experiencing difficulty.

For very many years naphthalene has given an immense amount of trouble in Ramsgate, and innumerable systems and experiments have been tried, with more or less temporary success, in order to overcome it. Some years ago, however, the writers came to the conclusion that, in preference to attempting to send out naphthalene-free gas, the best means of securing relief would be to provide the gas with sufficient solvent to either carry any naphthalene present to the point of combustion, or (in the event of condensation taking place in the mains) to ensure that the naphthalene came down in solution, when it would gravitate to the syphons and be disposed of in the usual way.

The means adopted to carry our conclusions into effect consist of a simple apparatus capable of atomizing a light hydrocarbon oil and bringing the gas into intimate contact with it. The lighter fractions of the oil thus atomized are carried forward mechanically with the gas, and are able to support any naphthalene present to the point of combustion, or, in the event of condensation, to retain the naphthalene in solution.



The "T.R." Sprayoil Apparatus for the Prevention of Naphthalene Troubles on the District.

[All Measurements Depend Entirely on Local Circumstances.]

The accompanying sketch shows the plant as installed at Ramsgate on the station meter outlet. The receiver below ground is filled with oil, and the pump started—thus forcing the oil under pressure through the special spray, as shown. The gas from the meter travels with the oil mist, and carries along with it a certain portion of the light oils. The remainder of the oil returns to the receiver, and again goes through the spray; and in this way a predetermined quantity of oil is circulated for twenty-four hours, when the residue is pumped out and replaced with fresh oil. By this time the residual oil will have absorbed naphthalene to the extent of about 4 per cent. of its volume; but, as it is capable of absorbing considerably more, the residual oil is allowed to circulate through a rotary washer-scrubber until, if desired, it is practically saturated with naphthalene. The residual oil could, of course, be used in the same way in any available washing plant or portion of a rotary washer-scrubber.

Dealing with the naphthalene already in the mains and services on the district, if a small quantity of the unsaturated residual oil is blown by a force pump through the service, and also introduced at the highest points into the mains, it will slowly gravitate to the syphons, from which it can be cleared. Owing to capillary action, the oil during its journey through the mains creeps up the sides until the whole inside surface of the mains is coated with oil. In this way deposits of naphthalene in the mains and services are effectually cleared out, and the oil coating continues to act as a preventative of further naphthalene deposits, and thus assists the work of the oil-spray apparatus, while at the same time providing a protection against corrosion in the mains.

The system above described has now been in continuous use at Ramsgate for two-and-a-half years. While we cannot claim complete immunity from naphthalene troubles, yet with a reduction of from 300 or 350 to less than 20 in the weekly number of complaints, we think we have got the trouble well in hand.

The "C" process for toluol extraction has now been in operation for several months, with fortunately none of the attendant naphthalene troubles which have been experienced in the majority of works.

The necessary plant is inexpensive, easily installed, and extremely simple to operate—in fact, in a short time it becomes merely a question of routine, attended when necessary by unskilled labour.

GAS CONSUMPTION IN GERMANY.

JULY TO SEPTEMBER, 1915.

STATISTICS of the decrease or increase in gas consumption in Germany for each month since the outbreak of war, compared with the corresponding month of the previous year, were given in the "JOURNAL" up to June last—[see "JOURNAL" for Sept. 28, p. 695]. Figures collected from 925 German gas-works show that in the month of July the gas production exhibited an increase of 3·2 per cent. over that for July, 1914; figures for 848 works show that in August last the gas production increased by 1·3 per cent., as compared with August, 1914, and by 8·47 per cent. as compared with August, 1913—the last August before the outbreak of war. Figures collected from 879 works show that in September last the gas production increased by 16·7 per cent., as compared with September, 1914, and by 5·49 per cent., compared with September, 1913. These figures indicate that the strenuous efforts which were made last year in Germany to substitute gas as a fuel in place of oil and coal, met with a very considerable measure of success.

According to the Central Gas Publicity Bureau at Berlin, a study of the detailed returns discloses some interesting facts as to the districts in which the increase has been greatest. For instance, at Königsberg, in East Prussia, the gas consumption in August last showed an increase of 110 per cent. over that for August, 1913; and for September last, an increase of 76 per cent., over that for September, 1913. These enormous increases—equivalent in August to more than a doubling of the gas consumption—are ascribed to the extensive use of gas for industrial purposes, which has been encouraged by exceptionally favourable rates of charge. But in East Prussia generally large increases are shown. In Memel, notwithstanding the Russian occupation, the increase in September, as compared with the same month of 1913, was 18·2 per cent.; in Allenstein, it was 43·8 per cent., in Braunsberg 37·2 per cent., and in Insterburg 42·4 per cent. Numerous places in West Prussia show an almost equally large increase in gas consumption. In the rest of Germany the increases are chiefly where industry or other conditions have been greatly favoured by war influences. Decreases on a considerable scale have occurred only in those places of which the industrial life has been seriously injured by the war. The decrease has been largely due to reduction in street lighting and in the lighting of places of public resort and restaurants. This reduction has been to a great extent balanced by the use of gas by very large numbers of new consumers.

A Course of Lectures by Dr. Bone.—Readers are reminded that Dr. William A. Bone, F.R.S., Professor of Chemical Technology at the Imperial College of Science and Technology, is giving a course of three lectures, on the "Utilization of Energy from Coal," at the Royal Institution, Albemarle Street, W., at 3 p.m. on Thursdays, Jan. 20 and 27, and Feb. 3.

Coal Shortage in Austria.—A Press Association telegram from Zurich states that many of the larger towns in Austria and Hungary are suffering greatly from shortage of coal, which seriously interferes with the gas and electric lighting. In Buda Pesth, the electric lighting of the streets has been suspended, and private consumers have been warned that their supply of electricity may be cut off at any moment. In Vienna, cooking by gas has been forbidden. At Brunn (the capital of Moravia), private persons are only permitted to burn 70 per cent. of their normal consumption at the ordinary rate of payment, and are charged double for all gas used beyond this limit. At Debreczin, the gas lighting of the streets has been stopped, and the gas supply of the largest consumers cut off entirely. At Stuhlweissenburg, gas may be burned for illuminating purposes only, between 3 in the afternoon and 11 o'clock in the evening; but its use for heating and cooking is prohibited.

GASEOUS COMBUSTION AT HIGH PRESSURE.

Abstract of a Royal Society Memoir.

On July 31 last, the Royal Society published in its "Philosophical Transactions" a memoir bearing the above title, containing a detailed account of an experimental research carried out by Professor William A. Bone and collaborators (with the aid of grants placed at his disposal by the Government Grant Committee of the Society) in the Coal Gas and Fuel Department of Leeds University during the years 1906 to 1912, to which reference was made in Professor Bone's recent British Association address.

As the results of this research have considerably extended our knowledge of the mechanism of gaseous combustion, and form a concluding chapter of the long series of investigations upon hydrocarbon combustion associated with Professor Bone's name during the past fifteen years, it will probably interest our readers—most of whom will not have an opportunity of studying the original memoir—if we attempt to review at some length its principal features. This, it may be said at once, is no easy task, for the research has been a very long and laborious one, characterized throughout by a wonderful thoroughness, patience, and experimental skill, and manifold theoretical issues arising during its course are critically handled and set forth in the original memoir with a clearness and ability which can hardly be approached in a review of this kind.

In order that the reader may understand the objects and scope of the work, it will be necessary to preface our review of it by a brief statement concerning the results of previous investigations by Professor Bone and other investigators in this department of scientific activity. As long ago as 1892 it was discovered, in Professor Harold B. Dixon's laboratory in Manchester, that an equimolecular mixture of ethylene and oxygen yields on detonation almost exactly twice its own volume of carbon monoxide and oxygen, in accordance with the empirical equation:

$$C_2H_4 + O_2 = 2CO + 2H_2,$$

And about the same time, Smithells and Ingle, in their researches upon the structure and chemistry of flame, discovered the occurrence of a larger volume of hydrogen and carbon monoxide in the interconal gases of the aërated hydrocarbon flames.

This led to the revival of an idea put forward as long ago as 1861 by Kersten—namely, that "before any part of the hydrogen is burnt, all the carbon is burnt to carbonic oxide, and that the excess of oxygen (if any) divides itself between the carbonic oxide and the hydrogen. The idea of a "selective" combustion, whether of carbon or of hydrogen, is, however, so repugnant to well-established principles that it could hardly be expected to meet with general acceptance in any final or complete sense, and there were many sceptics as to its validity. Moreover, while in the cases of acetylene and ethylene the assumption of a direct transition from the system

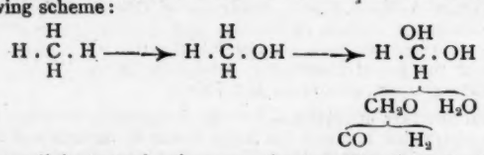
$$C_nH_m + \frac{n}{2}O_2 \text{ to } nCO + \frac{m}{2}H_2.$$

implies a simple transaction from the kinetic standpoint, an extension of the idea to the cases of such hydrocarbons as propane or propylene would obviously raise serious difficulties,

$$2C_3H_8 + 3O_2 = 6CO + 8H_2.$$
$$2C_3H_6 + 3O_2 = 6CO + 6H_2.$$

It therefore seemed necessary to consider whether the solution of the problem might not lie in the assumption of an initial association of the hydrocarbon and oxygen forming an unstable "oxygenated" or "hydroxylated" molecule.

This, broadly speaking, was the state of science with respect to hydrocarbon combustion when Professor Bone re-opened the subject experimentally about fifteen years ago. He soon succeeded in a series of crucial experiments disproving the Kersten doctrine of a preferential combustion of carbon, in substitution of which he put forward the view—which has since held the field and is now generally accepted by chemists—that not only in slow combustion, but also in hydrocarbon flame, the initial attack of the oxygen upon the hydrogen involves the formation of an intermediate "hydroxylated" molecule, which then is either further oxidized in like manner, or else decomposed into simpler products according to the temperature or other conditions as set out in the following scheme:



In a sufficient supply of oxygen the transition from the hydrocarbon to the dihydroxy stage is so rapid that no breaking-down of the molecular structure occurs in passing through the monohydroxy stage. When, however, the supply of oxygen is reduced below the equimolecular proportion, it is evident that the initial monohydroxy product cannot all be further oxidized to the dihydroxy stage. Some of it must therefore decompose, yielding, usually, steam as one product. The above theory therefore affords a complete explanation of the well-known fact that either ethylene or acetylene on explosion with its own volume of oxygen yields carbon monoxide and hydrogen without any separation of carbon or steam formation, because in each case the principal intermediate product is formaldehyde—which is a substance that decomposes straight into carbon monoxide and hydrogen at high temperatures.

Two groups of facts relating to explosive combustion which, while completely subverting the notion of any preferential combustion of carbon, harmonize very well indeed with the view of "hydroxylation."

(1) Whereas mixtures of olefines and oxygen corresponding to $C_nH_{2n} + \frac{n}{2}O_2$ behave on explosion like ethylene, inasmuch as they yield mainly carbon monoxide and hydrogen without any separation of carbon, similar mixtures of paraffins and oxygen—namely, $C_nH_{2n} + 2 + \frac{n}{2}O_2$—yield carbon oxides of carbon, methane, hydrogen, and steam, all in considerable quantities.

(2) That, even in the case of an olefine, if the proportion of oxygen be reduced below that indicated by $C_nH_{2n} + \frac{n}{2}O_2$, both carbon and steam are formed.

One of the most significant features of the experiments has been the proof afforded of the relatively greater affinity of hydrocarbons, as compared with either that of hydrogen or carbon monoxide for oxygen at the high temperature of flames. Thus, where a mixture of acetylene and electrolytic gas corresponding to $C_2H_2 + 2H_2 + O_2$ is exploded, there is absolutely no separation of carbon or formation of steam; and practically the same thing holds good in the case of a mixture of ethylene, hydrogen, and oxygen corresponding to $C_2H_4 + H_2 + O_2$. In each instance the hydrocarbon is burnt to carbon monoxide and hydrogen, just as would be the case were no hydrogen originally present in the mixture.

The foregoing work opened out the mechanism of the slow combustion of hydrocarbons, and led Professor Bone to predict that precisely similar conditions held for combustion, active enough to produce flame, and even detonation. That this prediction was open to criticism, by reason of the apparent difference possible between the molecular interaction, at comparatively low temperatures, and that existing in explosions, led to an experimental exposition of the facts as detailed below. Apparatus was accordingly constructed. Two explosion bombs were used, one cylindrical (fig. 1) and the other spherical (fig. 2), with special mixing devices, both tested to 1000 atmospheres pressure. These bombs were connected by stout tubes, through suitable cocks D, to gauges E, capable of registering small differences of pressure (fig. 3).

The whole are so mounted that quantities of pure gas from compression cylinders A (fig. 4) could, by the aid of a pump A B C (fig. 5), be forced into the bombs A (fig. 1) and there fired electrically.

Figs. 3 and 6 give the plan and elevation of the table as used in this research. C C C are the storage bombs, K is the standard Bourdon gauge, E E E are gauges reading to 100 atmospheres, D are three-way valves, and H the mixing valves.

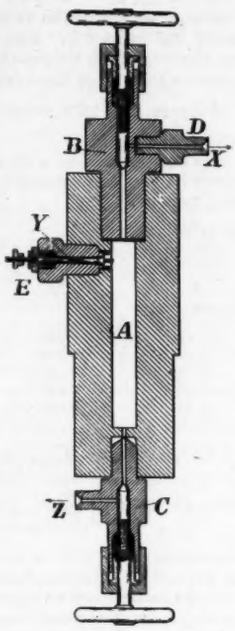
Fig. 7 is a representation of one of the four storage cylinders used. These cylinders are so soundly constructed that hydrogen at 100 atmospheres pressure can be stored for months without appreciable loss.

Fig. 5 is a pump capable of giving a capacity of 100 atmospheres, worked by hand and fitted with easily accessible valves. The pump functions in raising the mixture of glycerine and water from the reservoir G (fig. 8) and forcing it into the cylinder B for compression and subsequent transference to the cylinder C. The mixture of glycerine and water is kept in constant circulation—being alternately run out from the bottom of the compression cylinder B as each successive charge of gas is run in.

All the gases and the resultant products were carefully analyzed. After the bomb and its connections had been tested for tightness, it was exhausted and filled to five atmospheres pressure with oxygen; and, after blowing off the excess of pressure, it was again exhausted, and oxygen slowly admitted until the desired pressure was attained.

The valve of the bomb was closed, and the connections swept out with hydrogen at a greater pressure than that in the bomb, and the valve gradually turned to allow a very slow inlet of hydrogen to the desired partial pressure. The contents of the bomb were thoroughly mixed, and a sample then withdrawn for analysis. Where three gases were used in the bomb, a sample of the first two was always taken for analysis before admitting a third. The gauge readings were recorded, and the pressure registered was the bomb pressure with one atmosphere in addition, because the pressure indicated is above atmospheric.

After firing the mixture in the bomb and reducing the pressure in the connections to atmospheric, communication was established between the bomb and the gauge, which was read to within



X. To Mixing Valve and Standard Bourdon Pressure Gauge. Y. Ignition Plug. Z. To Gas Sampling Apparatus.

Fig. 1.

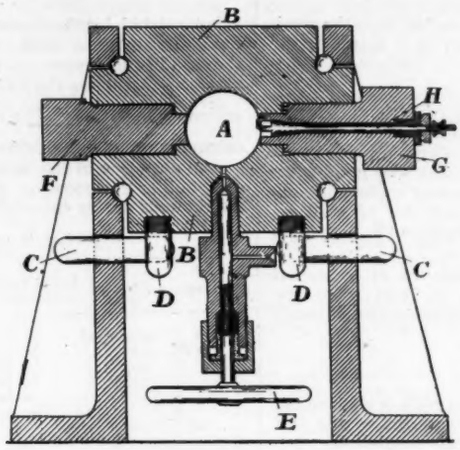
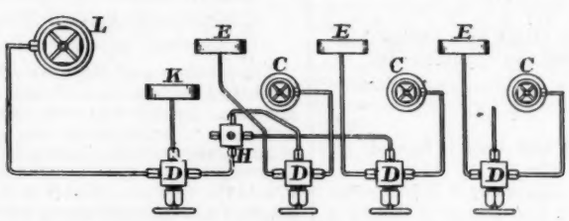
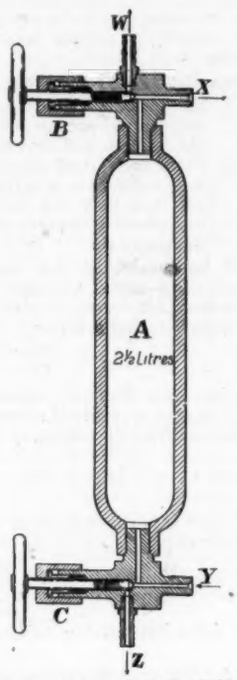


Fig. 2.



C. Storage Vessels. D. Three-Way Coned Valves. E. One-Hundred Atmosphere Bourdon Gauges. H. Mixing Valve. K. Standard Bourdon Gauge. L. Bomb "A."

Fig. 3—Plan.



W. To Twenty-litre Gasholder. X. To Storage Cylinder and Gauge, through the Three-Way Coned Valve. Y. From Compressing Pump. Z. To Reservoir for Compressing Fluid.

Fig. 4.

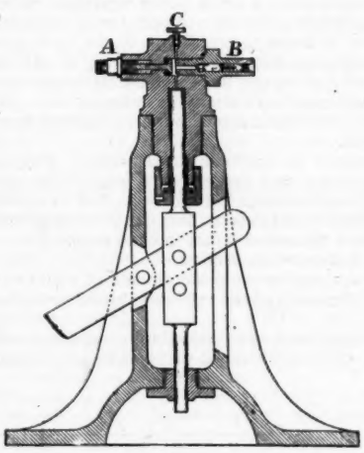
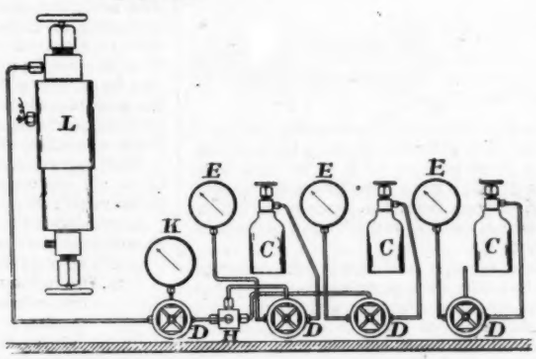


Fig. 5.



C. Storage Vessels. D. Three-Way Coned Valves. E. One-Hundred Atmosphere Bourdon Gauges. H. Mixing Valve. K. Standard Bourdon Gauge. L. Bomb "A."

Fig. 6—Elevation.

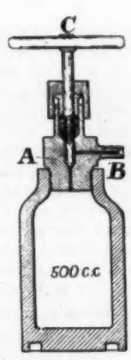


Fig. 7.

0·1 atmosphere. The reading, when multiplied by a predetermined constant and one atmosphere added, gives the pressure of the cold gaseous products in the bomb after explosion.

The above constant was the ratio of the volume of the bomb and the connections to the volume of the bomb itself. For gases, such as ethylene, which are readily liquefiable, corrections must be employed, on account of the deviation from Boyle's law.

Methane, with as nearly as possible half its own volume of oxygen, was exploded at initial pressures ranging from 8·5 to 31·25 atmospheres. The sound of the explosion up to 16·5 atmospheres is hardly perceptible; at 21·69 atmospheres, it was distinctly audible; and at 31·25 atmospheres, detonation was apparent. Carbon was deposited and steam abundantly formed in every case; and there was always a permanent increase of pressure of from 20 to 30 per cent.—the ratio p_2/p_1 increasing regularly with the initial pressure.

p_1 = the corrected initial firing pressure of the dry "nitrogen free" gases.

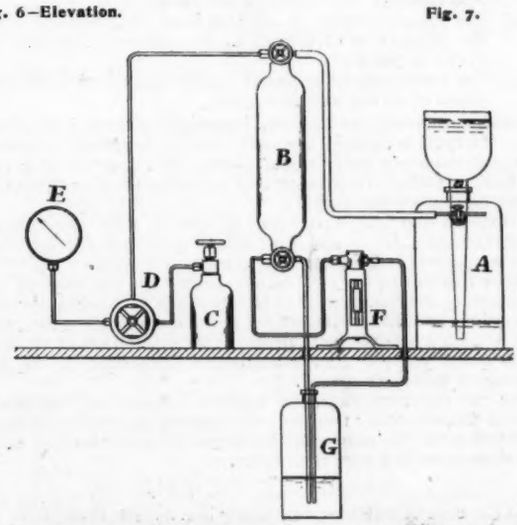
p_2 = the corrected final pressures of the cooled "nitrogen free" products.

There was an entire absence of ethylene or acetylene, yet often unchanged methane was present [*vide* table in "Phil. Trans." Series A, Vol. 215, p. 290].

The proportion of oxygen was then increased with a view to reaching a point at which no carbon was deposited; and this was observed for a mixture represented by

$$3CH_4 + 2O_2,$$

when not only was no carbon deposited with this mixture at an



A. Twenty-Litre Gasholder. B. Compressing Cylinder. C. Storage Vessel. D. Three-Way Coned Valve. E. One Hundred Atmosphere Bourdon Gauge. F. Compressing Pump. G. Glycerine and Wate Reservoir.

Fig. 8.

initial pressure of 12·6 to 12·75 atmospheres, but also the minimum quantity of oxygen occurred as steam as a result of the burning.

It may be concluded therefore that:

(1) The primary oxidation of the hydrocarbon is an exceedingly rapid process, and is probably completed between the ignition and the attainment of maximum pressure.

(2) There are certain secondary interactions whose influence may extend far into the long subsequent cooling period, for it is only the latter which would be affected by variations in the rate of cooling-down from the maximum temperature.

If it be considered that methane is built up of a methyl radicle—CH_3—and a hydrogen atom—*e.g.*, $H_3 : CH$—then the oxygen molecule forces its way into the methane, with the result that methyl alcohol is formed,

$$H_3 : C . OH$$
$$CH_3 . OH,$$

and it has been definitely established that at high temperatures methyl alcohol is resolved ultimately into carbon monoxide and hydrogen without deposition of carbon or steam formation

$$H_3 : C . OH = \begin{matrix} H \\ H . C : O \\ CO \end{matrix} \begin{matrix} \\ H_3 \\ H_2 \end{matrix}$$

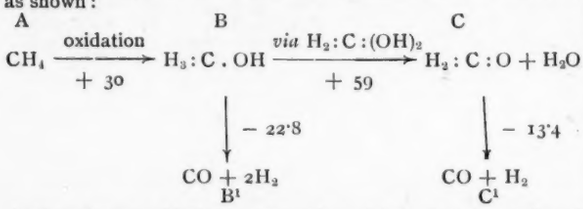
H : C . OH is apparently more open to attack by a further bombardment of oxygen, with the result that the "hydroxylate"

$$\begin{matrix} H \\ H . C . OH \\ OH \end{matrix}$$

breaks down immediately to H . C : O, and steam is formed.

$$\begin{matrix} \\ H \end{matrix}$$

Placing this on a thermal basis, and expressing it in kilograms-centigrade units per gram molecule, the distribution of energy is as shown:



As the primary oxidation is extremely rapid, the impetus gathered on the journey between A and B is sufficient to carry the reaction on to C, without stopping at B or passing to B^1. In fact, from the thermal point of view, a passage from A to B^1 would involve a far less quantity of heat given out from the system by oxidation, and more heat absorbed between B and B^1, than in the case of A to C, and subsequently to C^1.

From A to B^1, *plus* 30 units are lost and *minus* 22·8 units are absorbed; whereas from A to C^1 the heat given out is (30 + 59) = 89 heat units, and only *minus* 13·4 heat units are absorbed.

Methyl alcohol requires slightly more heat for resolution into its components than does methane itself—viz., 22·8 for methyl alcohol, and 22·7 for methane; so that in decomposing methyl alcohol any methane should be resolved readily.

The following facts must be considered:

(1) The ultimate formation of large quantities of both carbon and steam in the explosion of mixture $2CH_4 + O_2$.

(2) The disappearance of carbon from the products when the proportion of oxygen in the mixtures exploded exceeds 40 per cent.

(3) The occurrence of oxides of carbon and steam in the products of all the mixtures fired.

There is no difficulty in explaining, on the lines of the hydroxylation theory, the facts comprised under (1) and (3), especially in view of the strong tendency there would always be for a non-stop run from CH_4 to $CH_2(OH)_2$ without any breaking-down at the intermediate methyl alcohol stage.

To explain the non-separation of carbon with the mixture represented by $3CH_4 + 2O_2$, it must be considered that one-third of the methane is transformed into dihydroxy methane $CH_2(OH)_2$, the other two-thirds, for lack of oxygen, not getting beyond the monohydroxy methane stage (CH_3OH), thus restricting the decompositions to either the dihydroxy or the monohydroxy methane stages in such a manner as to preclude the separation of carbon. At the stage $3CH_4 + 2O_2$, a maximum proportion of oxygen occurring as steam was found.

From the foregoing data, the authors deduce that the likely course of the secondary reactions through the relatively long cooling period, after the maximum explosion temperature has been reached, involves the reversible change

$$CO + OH_2 \rightleftharpoons CO_2 + H_2,$$

also, in the case of mixtures containing less oxygen than $3CH_4 + 2O_2$, the interaction of steam and carbon represented by $C + OH_2 = CO + H_2$, or possibly some slight interaction between methane and steam.

While evidence points to the intervention of separated carbon in the chemical interation during the cooling period, methane in no way appears to be involved therein. This conclusion is substantiated by the experimental figures, as set out in the table below for mixture $2CH_4 + O_2$, showing the ratio "R," which the sum of the oxygen as H_2O, *plus* half the oxygen, as CO_2 in the products (assuming the CO_2 to have arisen wholly from the interaction $CO + OH_2 \rightleftharpoons CO_2 + H_2$) bears to the total oxygen originally present in mixtures fired in the experiments.

The deviation of this ratio from 0·5 may be regarded as a measure of the participation of separated carbon in the secondary interactions during the respective cooling periods.

Experiments with Mixture $2CH_4 + O_2$.

Experiment No.	Initial Pressure in Atmospheres.	*k*.	R.
1	8·53	4·45	0·473
10	12·74	3 65	0·487
2	13·62	3·76	0·472
3	16·45	3·78	0·450
4	21·69	2·56	0·420
5	31·25	2·24	0·400

Experiments Showing the Relative Affinities of Methane and Hydrogen for Oxygen in Explosions, and the Conclusions Arising Therefrom as to the Mode of Combustion of Hydrogen.

The previous work has shown that when the mixture $3CH_4 + 2O_2$ is reached, no deposition of carbon takes place on explosion under pressure. In this way, a comparison of the relative affinities of methane and hydrogen for oxygen respectively, under conditions of homogeneous flame combustion, may be made. This is of great theoretical importance, because it provides a basis for the discussion of the question whether or not the known rates of flame propagation through explosive mixtures of different combustible gases are governed by their relative affinities for oxygen, and affords decisive evidence as to the mode of combustion of hydrogen in explosions.

Previous researches have shown that in slow combustion in temperatures between 300° to 400° C., methane, ethane, ethylene, and acetylene are all oxidized at a much faster rate than either hydrogen or carbon monoxide; that in exploding such mixtures with H_2 the hydrocarbon is burnt in preference to the hydrogen. If a mixture in proportions represented by $CH_4 + O_2 + xH_2$ be employed, the division of the oxygen between the hydrogen and the methane during actual combustion may be deduced from the proportion of original methane in the final products, provided there is no separation of carbon.

The experiment consisted in exploding mixtures of $CH_4 + O_2 + xH_2$, in which hydrogen and oxygen were initially present in as nearly as possible equimolecular proportions, but in which x was varied between 2 and 8, and determining the percentages of the original methane which remained intact in each case.

1. The oxygen distribution when $x = 2$.
2. The influence of successive equal increments of x up to 8; the influence of the walls of the explosion vessel upon the results.

As the hydrogen was increased, the explosion became less and less violent; and when $x = 8$, only a slight puff was heard. In no case was carbon found.

Mixtures $CH_4 + O_2 + xH_2$.

x		2	4	6	8
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
Bomb A	O_2 to CH_4	95·34	81·0	54·9	31·4
	O_2 to H_2	4·66	19 0	45·1	68·6
Bomb B	O_2 to CH_4	97·10	91·0	72·6	..
	O_2 to H_2	2·90	9·0	27·4	..

The affinity of methane is at least twenty to thirty times greater than that of hydrogen, for oxygen, in explosions. The actual distribution of oxygen is influenced by the walls of the containing vessel, but not by the absolute initial pressure. Therefore the influence of successive increases in x (the volume ratio of hydrogen to methane in the mixture exploded upon the actual oxygen distribution) is, for a given vessel, proportional to x^2. This means that in explosion flames hydrogen is directly burnt to steam as a result of trimolecular impacts:

$$2H_2 + O_2 = 2H_2O.$$

It may be suggested here that this probably accounts for the observed greater affinity of oxygen for methane over hydrogen, since the oxidation of methane is due to dimolecular impacts; whereas in the latter hypothesis the oxidation of hydrogen is due to trimolecular impacts.

Experiments on the Relative Affinities of Methane and Carbon Monoxide for Oxygen in Explosions.

In this series of experiments, carbon monoxide was substituted for hydrogen, represented by $CH_4 + O_2 + xCO$. It was found that if x exceeded 3 there was a deposition of carbon, which rendered the experiments valueless for this particular work. The mixtures up to $CH_4 + O_2 + 3CO$ were exploded at an initial pressure of 24 atmospheres. It was found that between 8 and 9 per cent. of the original oxygen during the initial oxidation stage

had reacted with the carbon monoxide; the remainder having allied itself with the methane. The mixtures of methane, hydrogen, and oxygen, with those of methane, oxygen, and carbon monoxide, are tabulated below.

$CH_4 + O_2 + 2H_2$.				$CH_4 + O_2 + 2CO$.		
p_1		18·314	21·12	p_1	20·90	19·44
p_2		18·1204	21·082	p_2	22·66	21·33
p_2/p_1		0·989	0·998	p_2/p_1	1·085	1·097
		Atmospheres				
Partial pressure in original mixture	CH_4	4·424	5·48	CH_4	5·184	4·870
	H_2	9·486	10·08	CO	10·470	9·831
	O_2	4·404	5·56	O_2	5·248	4·473
		Atmospheres				
Partial pressure in gaseous products	CO_2	0·339	0·470	CO_2	1·963	1·758
	CO	4·049	5·168	CO	14·110	13·260
	H_2	13·61	15·290	H_2	6·320	6·106
	CH_4	0·1224	0·154	CH_4	0·266	0·207
$\frac{CO \times OH_2}{CO_2 \times H_2}$		3·75	3·77	$\frac{CO \times OH_2}{CO_2 \times H_2}$	3·64	3·56
Percentage distribution of oxygen deduced from unburnt CH_4	to CH_4	97·33	97·20	to CH_4	94·9	95·7
	to H_2	2·77	2·80	to CO	5·1	4·3

The outstanding feature of the above is the greatly inferior affinity of either hydrogen or carbon monoxide compared with that of methane for oxygen. It is quite possible, in the case of hydrogen-methane mixtures, to assign a numerical relationship. Thus in the case of $CH_4 + O_2 + 2H_2$ the ratio of the affinity CH_4/H_2 is of the order of 20 or 30 to 1 at least.

The want of information as to the precise mechanism of the carbon monoxide reaction renders a solution difficult. Nevertheless, from the comparison of the mixtures $CH_4 + O_2 + 2H$, and $CH_4 + O_2 + 2CO$ respectively, it may be observed that the carbon monoxide is more effective than hydrogen in pulling away oxygen from the methane. In the case of hydrogen, the influence of successive increments of x on the actual oxygen distribution is proportional to x^2; in the case of carbon monoxide, it is approximately x.

Here is to be discovered some fundamental difference between the modes of combustion of the two gases in flames. Where hydrogen is apparently burnt to steam, by reason of trimolecular collisions, $2H_2 + O_2 = 2H_2O$, the results with mixtures $CH_4 + O_2 + CO$ require some different supposition, such as an intermediary action of steam.

Explosion of Ethane with its own Volume of Oxygen.

No theory of hydrocarbon combustion can be complete until a thorough understanding of the *modus operandi* of an equimolecular mixture of ethane and oxygen on explosion is obtained. Such a mixture should, on explosion, give rise to carbon monoxide and hydrogen without separation of carbon or steam formation, as represented by $C_2H_6 + O_2 = 2CO + 3H_2$; and as carbon monoxide and hydrogen are mutually inert in flames, the final results should not be effected by alterations in the initial pressures of the rate of cooling of the products.

Experience, however, shows that the above is not the course of the reaction; for examination of the products reveals carbon, methane, steam, aldehydic vapours, as well as oxides of carbon and hydrogen. The hydroxylation theory should predict this "non-stop" run, through the monohydroxy and the dihydroxy compounds—viz., $C_2H_5OH\ (OH)_2$, which decomposes, yielding aldehyde and steam—the acetaldehyde, in turn, breaking up into carbon, hydrogen, methane, and carbon monoxide, in accordance with the scheme:

$$\begin{matrix} H. \\ H.C.H \\ H.C.H \\ H \end{matrix} \rightarrow \left[\begin{matrix} H \\ H.C.H \\ H.C.OH \\ H \end{matrix}\right] \rightarrow \left[\begin{matrix} H \\ H.C.H \\ H.C.OH \\ OH \end{matrix}\right] \rightarrow \left\{\begin{matrix} (1)\ CH_4 + CO \\ (2)\ C + 2H_2 + CO \end{matrix}\right\} + H_2O$$

$$H_2O + H_3C.CHO$$

explains all the facts.

It is well to closely examine (1) the behaviour of a mixture $C_2H_6 + O_2$, whether inflamed at less than atmospheric pressure, in glass vessels presenting varying surface areas to a fixed volume of combining gas, or detonated in a lead coil at 900 to 1200 mm. pressure, is evidence that rapid cooling favours the survival of aldehyde and unsaturated hydrocarbons, that a longer duration of the flame facilities the separation of carbon at the expense of the aldehydes and saturated hydrocarbons, simultaneously leading to the secondary reduction of steam by carbon. Nevertheless, 17 to 20 per cent. of the original oxygen appeared as steam in the final products.

A careful study in the light of the above facts was then instituted on the behaviour of the mixture when exploded in the bomb at initial pressures between 10 and 40 atmospheres. In all cases there was a deposition of carbon and condensation of steam on cooling. The ratio p_1/p_2 in the different experiments varied between 1·85 and 2·05. No acetylene or unsaturated hydrocarbons remained in the final products, although methane in considerable quantities was present. This seems to point to the fact that the violence of the explosion shatters the acetylene and unsaturated hydrocarbon molecules, while the methane remains intact.

Explosion of Mixture $C_2H_6 + O_2$ at High Pressures.

The following table is an epitome of some of the results:

Experiment No.		53.	55.	57.
p_1 atmospheres		10·90	18·53	39·63
p_2 atmospheres		20·56	37·22	73·40
p_2/p_1		1·88	2·0	1·85
Partial pressures in original mixtures in atmospheres	C_2H_6	5·54	9·20	20·15
	O_2	5·36	9·35	19·50
Partial pressures in gaseous products in atmospheres	CO_2	0·750	1·04	3·15
	CO	7·525	14·14	27·35
	H_2	10·830	19·76	34·70
	CH_4	1·635	2·28	8·20
Per cent. carbon deposited		11·7	5·0	4·0
Per cent. original oxygen appearing as H_2O in final products		19·0	13·1	13·8

There is no direct relationship between the relative affinities of methane, hydrogen, and carbon monoxide, respectively, for oxygen in hydrogeneous flame combustion, and the rates of flame propagation through explosive mixtures, in which the combining gases are present in proportion corresponding to the effective primary reactions concerned. Do such chemical factors control the rates of attainment of maximum pressures in explosions? In order to answer this question, "air mixtures," whose composition may be written:

$$CH_4 + O_2 + 4N_2$$
$$2H_2 + O_2 + 4N_2$$
$$2CO + O_2 + 4N_2$$

were used on account of the insuperable difficulties in obtaining pure oxygen mixtures. The gases were fired in the spherical bomb to which was attached a Petavel recording manometer (fig. 9). For a description of this instrument, readers are referred to the "Phil. Trans.," 1905, Series A, Vol. 205, p. 363.

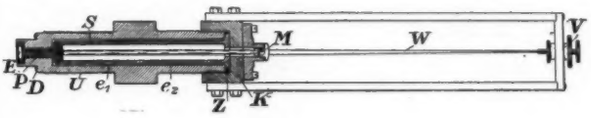


Fig 9.

The gauge is screwed into the explosion chamber by means of the thread U. The mirror M (focal length of about 2·5 feet) is attached to a lever, and at the commencement of the experiment is in the zero position, held there by the stretched piano wire W. Adjustments are made by the screw V. The source of light was an arc, and the beam was reflected on to a photographic film fixed on the drum A of the chronograph (fig. 10).

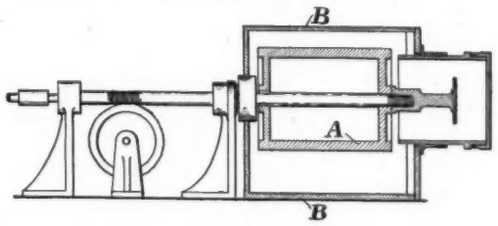


Fig. 10.

The drum is rotated at a constant speed of between 200 and 600 revolutions per minute by means of an electric motor, and is enclosed in a light-tight aluminium case B B, provided with a longitudinal slit. An electrically controlled tuning fork was used as a time indicator; the fork being so placed that each vibration momentarily interrupted the light falling on the film, thus producing a dotted record on the pressure curves.

It became evident from these experiments that the hydrogen air mixture is the "fastest burning;" the maximum pressure being reached in approximately the time taken by the slowest burning mixture—viz., carbon monoxide—air (*i.e.*, 0·01 second, as compared with 0·10). The time required in the case of the methane-air mixtures (0·05 to 0·08 second) was at least five times as long as the hydrogen-air mixtures, notwithstanding the fact that the affinity of methane is twenty times as great as that of hydrogen for oxygen in flames.

Apparently, therefore, there is no relationship between the actual rate at which the potential energy of an explosive mixture is transferred on explosion as sensible heat to its products and the magnitude of the chemical affinity between its combining constituents.

The extreme slowness of the cooling, after the attainment of maximum pressure, is evident from the curves, figs. 11, 12, and 13,

which are plotted with pressure measured in atmospheres as ordinates and time in seconds as abscissæ.

This was particularly marked in the case of the methane-air mixtures, in which there was hardly any appreciable cooling during an interval of 0·22 second after attainment of maximum pressure. The circumstance may possibly be attributed to: (1) The combustion taking place in well-defined chemical stages, and also (2) the operation of the endothermic secondary interaction between carbon monoxide and steam during the cooling period. The cooling is rather more rapid in the case of carbon monoxide air mixture, and still more for the hydrogen air mixture.

In conclusion, then, it is definitely proved that: (1) Methane has a greater affinity for oxygen than either hydrogen or carbon monoxide. (2) There is no direct relationship (if any) between the relative times required for the attainment of the maximum pressure and the relative affinities of the combustible gases respectively for oxygen.

E. S.

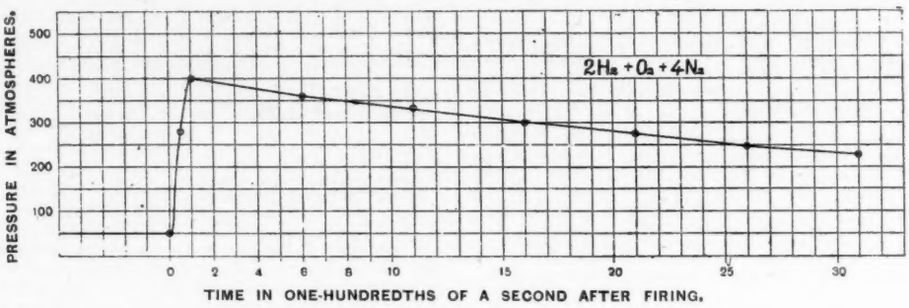


Fig. 11.

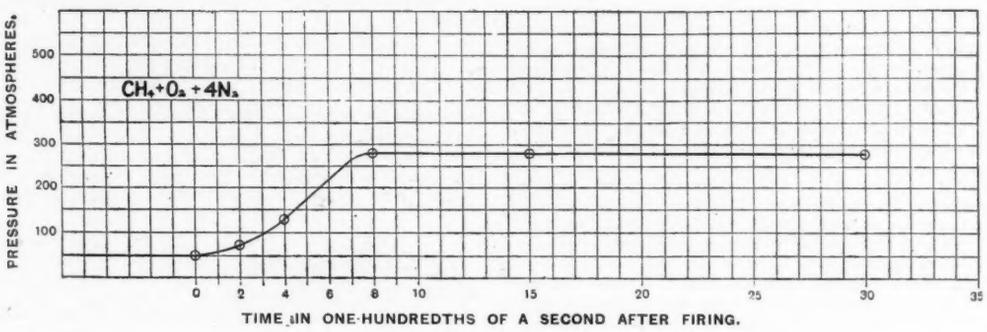


Fig. 12.

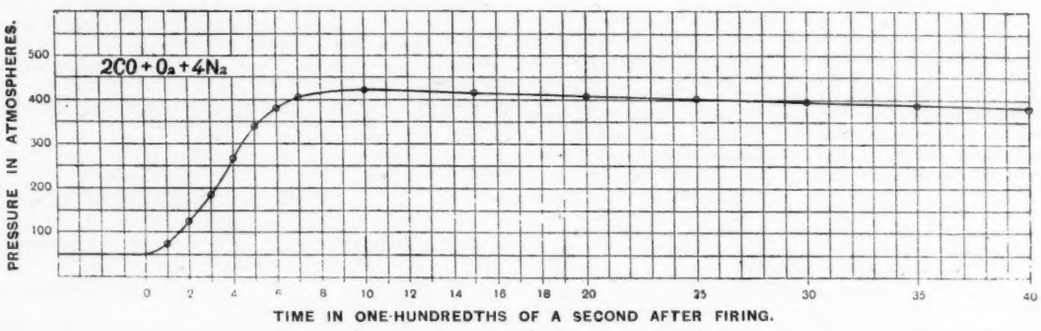

PRESSURE IN ATMOSPHERES.
500
400
300
200
100
$2CO + O_2 + 4N_2$
0 2 4 6 8 10 12 14 16 18 20 25 30 35 40
TIME IN ONE-HUNDREDTHS OF A SECOND AFTER FIRING.

Fig. 13.

GAS-ENGINES AND THEIR CAPACITY FOR DEALING WITH PEAK-LOADS AND OVERLOADS.

By H. C. Widlake, M.J.Inst.E., of the Plymouth and Stonehouse Gaslight and Coke Company.

In an article, on "Power Production—the '£ *s. d.*' of the Question," published in the July 13 to Aug. 3 issues of the "Journal" last year, the author expressed the view that individual driving by electric motors could not, so far as the small factory proprietor was concerned, be regarded in the light of a commercial proposition, in view of the fact that each motor has to be rated so as to be capable of handling the maximum load provided by the machine to which it is coupled, and that it would consequently be operating for the greater portion of its time under an uneconomical load factor.

This statement was severely handled by one of the Electrical Journals, whose reviewer, in the course of his criticism, remarked that, "if anything is clear from these rather muddled sentences, it is that Mr. Widlake is ignorant of the overload capacity of the electric motor. Moreover, he says nothing of the fact that when a works is driven by a gas-engine, that engine which has no overload capacity worth mentioning must be equal in capacity to the maximum demand of the factory, although the average demand may be and would be, in the vast majority of cases, very much less." This criticism was dealt with at length in an article, entitled "Overload Capacity and Individual and Group-Driving," published in the "Journal" for Aug. 24.

The author has recently been engaged upon a series of observations in connection with the plant at a local power laundry, and the results of these observations have been so utterly at variance with the latter portion of the above-quoted criticism as to quite warrant their publication in further answer to the contention of the electrical enthusiast that a gas-engine has no appreciable overload capacity.

The laundry in question has already provided interesting data for readers of the "Journal," in connection with some rather striking economies which were effected by the replacement of an electric motor by a gas-engine in connection with the driving of hydro-extractors. In the article referred to [June 22, 1915] brief

mention was made of the low cost at which a 15 B.H.P. gas-engine operated all the other machines in the building; and in the present article it is proposed to deal with the actual maximum demand created by these machines, and to consider this maximum in conjunction with the rated horse power of the gas-engine.

The following list shows the machines with which each floor of the laundry is equipped; and against each machine is placed its maximum demand.

GROUND FLOOR (WASHHOUSE).

[Excluding the two 38-inch hydro-extractors driven by a 6 B.H.P. gas-engine.]

One 26-inch hydro-extractor	2·5
One 24-inch ,, ,,	2·5
One 250 shirt washing machine	2·5
Three 200 shirt washing machines, at 2 H.P.	6·0
One 100 ,, ,, ,, ,,	1·0
One 80 ,, ,, ,, ,,	1·0
Two "Vowel" washers, at 1½ H.P.	3·0
Total maximum H.P. required	18·5

FIRST FLOOR.

One 108-inch "Decoudin"	2·0
One 40-inch ,,	2·0
Two 108-inch callenders at 2 H.P. each	4·0
One 36-inch fan	1·25
Total maximum H.P. required	9·25

SECOND FLOOR.

Four collar machines at ¼ H.P.	1·0
Two shirt machines at ¼ H.P.	·5
Two goffering machines at ⅛ H.P.	·25
One shirt banding machine	·125
One collar curling machine	·125
One starching machine	·25
Two 12-inch fans at ¼ H.P. each	·5
Total maximum H.P. required	2·75

Summarizing, the maximum demand for power which these three floors may create, provided that the maxima of the individual machines occur simultaneously, will be as follows [neglecting transmission loss for the moment]:

Ground floor	18·50
First floor	9·25
Second floor	2·75
Maximum demand	30·50 horse power

Under the actual working conditions pertaining in this laundry, the three floors are working together five days of the week, while for the remaining two days at least 60 per cent. of the average demand for power maintained during the five days is required. Large Government contracts are held, which necessitate working through the week-end; and the character of the materials handled in connection with these contracts is such as to tax the wash-house machinery to its utmost.

The load of the three floors is dealt with by a gas-engine, built in 1905 and rated at 15 B.H.P., which drives direct on to the wash-house main-shafting. A belt-drive from this main shafting drives the overhead shaft on the first floor, from which the callenders and "Decoudins" take their power, and from which the small finishing machines on the top floor are under-driven. The power from the gas-engine to these various machines is transmitted *viâ* 170 feet of shafting (including five countershafts), 32 plummer blocks, and 52 belt-drives.

It is rather difficult to decide exactly what amount of power is absorbed by the above transmission details, but it is certainly not less than 4 to 5 B.H.P. Assuming this loss to be represented by the very low figure of 4 B.H.P., we may now say that the maximum demand alluded to in the criticism mentioned at the beginning of this article is 34½ H.P.

We have been told that "when a works is driven by a gas-engine, that engine which has no overload capacity worth mentioning must be equal in capacity to the maximum demand of the factory." We have here a load whose possible maxima (on which basis we are told the engine should be rated) are about 34 B.H.P., which for years has been satisfactorily handled by a 15 B.H.P. gas-engine. The diversity factor seems all on the wrong side, yet the job goes on all right. There are no complaints; the engine shows no sign of distress, never pulls up, and does not overheat.

In the article on the driving of hydro-extractors published in the June 22 issue of the "JOURNAL," the running costs for this engine for the year ending Michaelmas, 1914, were shown to be very low—namely, 5½d. per hour. During the twelve months ending Michaelmas, 1915, the price of gas in the district was advanced by about 19 per cent.; but, while the running hours of the engine under the same load have been greater than during the preceding twelve months, the costs per hour are only about 5·8d., including interest, depreciation, and lubrication.

The following figures show the result of a series of observations taken recently of one day's run of this engine:

Meter reading—Dec. 29, 1915, 11 a.m.	991,900 cubic feet
Dec. 30, 1915, 11 a.m.	994,800 ,,
Gas consumed	2,900 cubic feet
Working hours	10½
Gas consumed per hour	280 cubic feet
Average load, assuming an engine efficiency of 20 cubic feet per B.H.P. hour	14 B.H.P.

Now it seems fairly obvious that the individual maxima of the various machines rarely occur simultaneously. But on the other hand it is equally obvious that with such a plant being run at its utmost capacity, there must be constantly recurring peak-loads, whose effect must be to tax the engine far beyond its rated power; and in view of the fact that stoppages due to overload are practically unknown the question naturally arises, "How are such peak-loads met?" The answer is, by the overload capacity which all well-designed gas-engines possess, and which for obvious reasons is always belittled by those interested in electrical driving. By virtue of the energy stored up in the heavy revolving rim of the gas-engine's flywheel the machine possesses a tremendous capacity for dealing with the momentary peak-loads which are so constantly arising in a factory of this kind.

Overloading is a prolific cause of breakdowns among electric motors. But a gas-engine cannot be overloaded in the same sense of the word as can an electric motor, and for these reasons: The immediate result of an overload on an electric motor is a drop of speed, and hence of counter or opposing pressure, as a result of which an increased current passes through its windings, the purely ohmic resistance of which is insufficient to prevent the passage of a destructive current. Assuming the continuance of a bad overload, this current is only limited by the melting point of the fuses in circuit. This current will probably pass through two sets of fuse-boxes, one pair under the control of the electric supply authorities and one pair embodied in the motor control-gear and in the charge of the machine attendant. The fuses in the boxes under the control of the supply authorities will be rated on the maximum demand of the building, and will not, generally speaking, blow on account of a fault on one individual machine.

It consequently follows that the current passing through the windings of the overloaded motor will be limited by whatever happens to be connected across the terminals of the motor fuse-boxes; and those who have had experience of electric motors operating under the charge of handy men will quite understand why the author prefers to refer to the contents of the boxes in this very vague manner. It may be wire nails, hair pins, copper, brass, or iron wire; but the last thing one would expect to find is a properly rated fuse.

Now the motor has, generally speaking, an unlimited supply of power behind it, and will continue to draw on this supply far in excess of its rated safe load, until its fuse blows and brings it, together with the load to which it is coupled, to a standstill.

Let us take now the case of the overloaded gas-engine. The maximum power it is capable of exerting is dependent upon the number of maximum impulses it is receiving per minute. While like the electric motor it may have an unlimited supply of raw power behind it for conversion into mechanical energy, the very principles on which it operates enable it to protect itself against the injurious consequences of a heavy overload.

A well-designed gas-engine is rated upon a normal working load and has a certain reserve of power (say from 15 to 20 per cent.), which is always available for dealing with any excess demand which may arise. The immediate result of an overload on a gas-engine is a tendency on the part of the machine to slow-up; and the energy stored up in the heavy revolving rim of the flywheel will commence to expend itself in an attempt to meet the increased demand.

If the overload be just momentary, the fly-wheel effect will be sufficient to carry the engine over this period of increased demand; and as soon as the load again falls to normal, the engine will work itself up to the speed at which it was running before the occurrence of the overload. But if, on the other hand, the demand for extra power is not a peak-load of merely short duration, the speed of the engine will fall to the point at which the governors come into operation and increase the number of explosive strokes in the case of an engine governed on the "hit and miss" principle or the strength of the charge in the case of a throttle-governed machine.

The greater portion of peak-loads in factories is brought about by the starting-up of standing machines—thus causing a demand for power to accelerate these machines from a state of rest to full speed. The power required for this purpose may be many times greater than the power actually required to keep the machines running when once full speed has been attained. After the machines have been started, the engine will, of course, take a little more gas, in order to deal with the legitimate increase in load caused by the putting of the machines to work; but the increased power required for starting them from a state of rest is mostly met by flywheel effect.

There is a limit to the overload which any prime mover can sustain without injuring itself. A gas-engine slowing-up under an overload takes more and more power, by virtue of its governing principles, until this limit is reached, when, if the speed still continues to fall, so likewise does the power supplied to the engine fall off, and so save the machine from that rush of raw power which, under the conditions, it cannot convert into mechanical energy without detriment to itself.

Now in the case of an electric motor this limiting point is not in any way fixed by the design of the machine, but is dependent upon the rating of the fuse. An electric motor slowing-up under an overload will take more and more current from the supply mains as the speed falls; and if the fuse, for any reason, fails to act, or does not act at the proper current value, the result will probably be that the insulation of the windings will deteriorate to a great extent (even if the windings have not been actually burnt-out), owing to the heating effect due to a much greater current than the motor was designed to operate under.

The statements set forth in this article relating to the 15 B.H.P. gas-engine are confirmed by the conditions under which the laundry referred to was worked prior to the installation of the engine. The business started in 1896 with a 6 B.H.P. gas-engine, and a load of certainly not less than 20 B.H.P. (based on the sum of the individual maxima of the machines installed). For nine years the little engine handled the load, and only in 1904 (when the management were considering the putting down of some extra machines) was it decided to replace it by a larger engine. For some years the engine lay idle most of its time, being merely regarded as a stand-by; but in 1914 it was put into service for the driving of two 38-inch hydro-extractors, as described in the "JOURNAL" for June 22 last. Since that date it has been on this load for 10 hours a day, 300 days per year, and runs at an efficiency of 24 cubic feet per B.H.P. hour. So that the experience of the user of this engine can hardly be said to be that its efficiency has decreased largely with age.

The cases of these two engines are simply ones which happen to have come under the writer's notice, and are plain statements of facts open to any inquiry or investigation. There are thousands of such cases in all parts of the country—cases in which old gas-engines, which by all the rules laid down by electrical men for their depreciation should now be on the scrap-heap, are giving excellent service, year in and year out, with a degree of reliability and economy which cannot be equalled, much less excelled, by any other type of the latest power generators.

Particulars such as those given in the preceding paragraphs are unfortunately difficult to obtain; and the author cannot help thinking that it would be well worth the while of gas-engine manufacturers to get together some data regarding their clients' engines, and make use of the same in their publications. If this were done, perhaps we should hear less of the misleading statements made by electric motor manufacturers in regard to the relative overload capacities of the gas-engine and the electric motor.

REPAIRING A SHELL-DAMAGED GASHOLDER AT LILLE.

THE "Journal für Gasbeleuchtung" of Dec. 25 gave a report, dated Aug. 1, 1915, by Captain Westphal, the Chief of the Electrical Section of the German Army at Lille, on the repair of a gasholder in that town in Northern France, which had been somewhat damaged by shell-fire in the bombardment of the town in October, 1914.

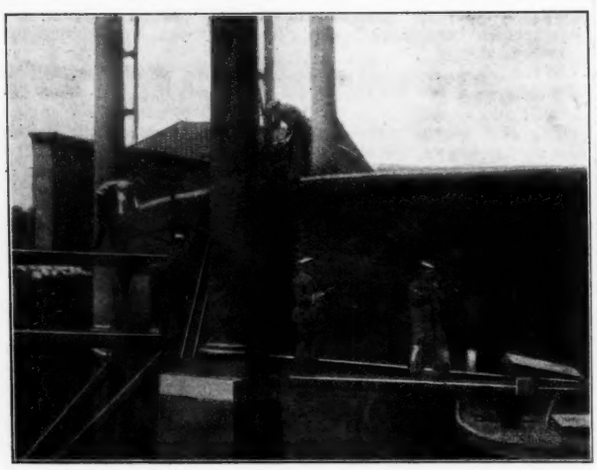
The gasholder, which has a capacity of 127,000 cubic feet, is at the St. André sub-station of the gas undertaking, in the Rue de la Caserne. It is a two-lift holder; and at the time it was struck it contained about 106,000 cubic feet of gas. A shell penetrated the side of the top lift, 40 inches below the top curb, causing a hole as big as a man's fist. It did not, however, ignite the gas at this hole. It burst in the holder, about 5 feet from the cup, and ripped in the side sheets a hole about 32 inches long and 24 inches wide. Fragments caused about seventeen holes, small and large, in the side of the upper lift. The gas issuing from the hole caused by the shell-burst ignited, and produced an enormous jet of flame which extended across the street (which is 40 feet wide) and set fire to the woodwork of a house on the opposite side. The gasholder was emptied in a few minutes, and there was no big conflagration.

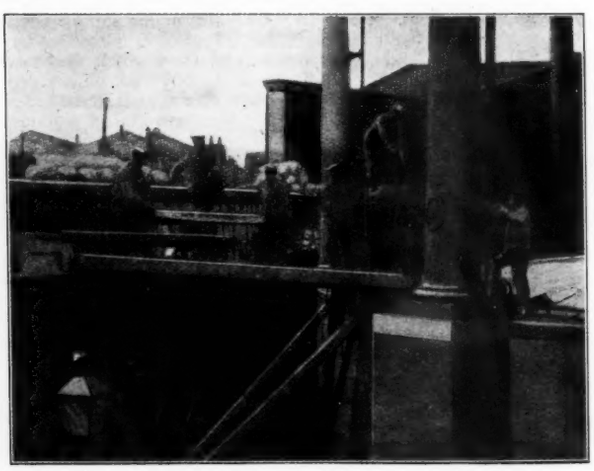
Though the works of the gas undertaking together had still sufficient holder accommodation, it appeared desirable to restore the holder to a usable condition, as it had to be borne in mind that at any time another gasholder might be destroyed by hostile artillery or bombs from aircraft. The gas and electricity works (the report states) appear to present a special attraction to the airmen, as bombs have twice been dropped in the immediate neighbourhood of the Wazemmes Gas-Works on the Boulevard Montebello, without, however, doing damage to the gas-works itself.

In order to repair the gasholder, it was necessary to raise the inner lift, which weighed about 16 tons, sufficiently high to give room to work between the bell and the wall of the masonry tank. Lifting appliances for raising the bell as a whole were not available; and recourse was therefore had to the following expedient. The tank, which was 26 ft. 3 in. deep and contained about 530,000 gallons of water, was first emptied by an 8-horse power petrol engine driving a centrifugal pump and a pulsometer. In default of large pulley blocks, six wooden trestles were set up between the guide columns; and on each of these was placed a cross-bar consisting of a long square baulk of timber. To one end of the cross bars, forming the arms of levers, were attached (by 5-feet screws) pendants of stout flat iron, 26 ft. 3 in. long. In order to balance the weight of the bell and the iron pendants, the other end of each cross-bar or lever was loaded with thirty large sacks of sand. The end of each pendant was bent round so as to form a hook, with which the bell was gripped, and then raised about 10 ft. 6 in. by the six spiral screws uniformly applied.

For greater safety, the bell was then propped up by six cross-head piles, and the holder being empty both of water and gas, it was then convenient and safe to work both from the inside and in the space between the bell and the wall of the tank. The tackle used was partly procured from a boiler works at Fives, and partly prepared in one of the shops of the gas-works. The work was carried out in about four weeks by the electrical section of the militia (under whose officer the administration of the gas-works has been placed) and the ninth company of garrison railway engineers. When the damaged plates had been renewed or repaired, the holder was cleaned and painted by civilian labour, and then again brought into action.

The two illustrations from our contemporary show the holder in course of repair.





REPAIRING A SHELL-DAMAGED GASHOLDER AT LILLE.

SOME PRINCIPLES IN INDUSTRIAL LIGHTING.

At the Meeting of the Illuminating Engineering Society last Tuesday, at the Royal Society of Arts, Mr. J. S. DOW read a paper on the above subject, with special reference to the report of the Departmental (Home Office) Committee on the Lighting of Factories and Workshops. The paper was of considerable length; and we give here only the principal points.

The object of the paper is to show, by a few typical examples, how the requirements of the Home Office Departmental Committee's Report on Factory Lighting can be readily met by modern methods, and to summarize the situation as regards planning installations.

Adequate and suitable lighting, it is suggested by the report, should comply with the following requirements: (1) Adequacy. (2) A reasonable degree of constancy and uniformity of illumination over the necessary area of work. (3) The placing or shading of lamps so that the light from them does not fall directly in the eyes of an operator when engaged on his work, or when looking horizontally across the workroom. (4) The placing of lights so as to avoid the casting of extraneous shadows on the work. In addition, there are the provisions 2 to 7 in the report, relating mainly to the minimum degree of illumination (0·05 to 0·4 foot-candle, according to circumstances), which is considered necessary in the interests of safety.

PROVISION OF REQUIRED ILLUMINATION.

As to adequacy, it may be presumed that the amount of light for carrying on work would only be deemed inadequate when it

was obviously below the standard usual for the process in question, and manifestly a hindrance to the worker. We have, however, in Vol. III. of the report, some excellent information as to the conditions which already exist. One of the first things which strikes one in reading these data is the variety in the amount of illumination afforded in different factories for similar processes. It is evident that a general agreement as to standards would be very helpful in removing these anomalies. Lighting experts would probably agree that the average values of illumination recorded in these tables could be quite easily provided by modern methods without undue expense; and possibly these averages might furnish a rough indication as to the amount of illumination desirable for the class of work.

After examining the figures, one appreciates the wisdom of drawing a distinction between the general illumination necessary in the interests of safety, and the illumination for the carrying out of work. The existence of a moderately high illumination at floor-level does not imply that the illumination on the work is ample. Conversely one may find a high illumination on the work but very little on the floor. On the other hand, when the nature of the work and the arrangement of the machines render it desirable to aim at a high general working illumination throughout the room, one usually provides this illumination by means of sources mounted near the ceiling. In such cases, the mere fact of providing adequate illumination for the work should ensure that the minimum value in the interests of safety and convenience will be everywhere exceeded.

These conditions are probably more typical of factories in London than the mills and workshops, covering a very extensive area, in the provinces. I think, however, that even in large covered areas, where there are spaces between the points where work is done, and where it would be uneconomical to flood the entire floor-area with light, there ought to be no difficulty in providing sufficient to ensure a minimum of 0·25 foot-candle; and in practice 0·5 foot-candle might be aimed at. Probably there are few cases in which a system of general lighting would be installed with the deliberate intention of producing an even general illumination of this value. From the discussion at the meeting on Nov. 23, it would appear that the general illumination prevailing in modern factories is apt to be over-estimated. A general illumination of 3 foot-candles appears to be extremely rare. From the report, it is seen that 2 foot-candles was only attained in 3 per cent. of the factories visited, while 28 per cent., or nearly a third, fell below the minimum of 0·25 foot-candle suggested. If, therefore, all factories were brought up even to this level, a substantial improvement would have been made. The well-known booklet on industrial illumination, issued some years ago by the National Electric Light Association, summarized the usual practice for various trades in a very admirable manner. After examining these figures closely, one is inclined to think that perhaps it is hardly necessary, with our present knowledge, to attempt to discriminate quite so closely between the requirements of different operations as in this production. The following rough classification contained in the recent code prepared by a Committee of the American Illuminating Engineering Society might perhaps serve as a useful guide:

Class of Work.	Minimum Illumination Foot-Candles.	Desirable Illumination Foot-Candles.
Storage, passage-ways, stairways, and the like	0·25	0·25—0·5
Rough manufacturing and other operations	1·25	1·25—2 5
Fine manufacturing and other operations	3·5	3·5 —6·0
Special cases of fine work	—	10—15

It may be suggested that almost all industrial operations might be classified under one of these heads, so far as the amount of illumination required is concerned. It should be particularly noted, however, that merely specifying a certain illumination on the work is not enough to secure "adequate and suitable lighting." The illumination must also comply with the requirements stated above as regards uniformity of illumination over the working area, avoidance of glare, and avoidance of inconvenient shadows. The provision of a uniform illumination is mainly a matter of arranging the lighting units at suitable distances apart, according to their distribution curves; and wherever it is necessary to light a large area equally at all points, a high standard of uniformity can be obtained. In such cases a variation of not more than 25 per cent. on the work might perhaps be anticipated.

Avoidance of Glare.

The next consideration, the avoidance of glare, is an exceedingly important one. This is the requirement which, of all others, is apt to be disregarded in factory lighting; and Vol. III. of the Home Office Committee's report contains frequent objections to installations on this ground. Yet, so far as those who scheme factory installations are concerned, there is now general agreement that glaring points of light within the range of vision should be avoided, and the explanation of defective installations lies more often in the indifference of the public who have not yet learned that exposed brilliant lights are necessarily wasteful, and even insist on them. By the aid of modern appliances, it should be practicable in almost every variety of installation to comply with the Committee's suggestion—viz., "the placing or shading of lamps so that the light from them does not fall directly on the eyes of the operator when engaged on his work or when looking horizontally across the workroom." The installations where it would probably be most difficult to meet this requirement are those carried out in rooms with rather low ceilings. However, seeing that the use of an appropriate reflector almost invariably tends to increase the light on the work, there is clearly no hardship in asking that such lights should be screened.

Avoidance of Inconvenient Shadows.

The last requirement, relating to the avoidance of inconvenient shadows, is clearly one the application of which will have to be studied by practical experience. For the present, no doubt it would serve chiefly to enable inspectors to advise managers of factories to make small adjustments in the positions of lamps, &c., in cases where the wrong direction of light, by causing a deep shadow, was obviously causing inconvenience to a worker, or a possible source of danger. As instances, one might mention the presence of an inconvenient shadow at a cutting edge or circular saw, or the shadows thrown by projecting masses of machinery causing moving parts to be in semi-darkness.

Prediction of Illumination.

As to whether it is practicable to determine in advance the actual illumination that will result from a given arrangement of lighting units in specified positions—to make sure, in fact, not only that the requirement as regards the minimum general illumination for safety in working areas is satisfied, but that the illumination at the point of work is also ample—to those who are responsible for the planning of lighting installations, it may seem almost superfluous to raise this question. It was conclusively shown, in a paper by Mr. Clinton before this Society in 1914 that, by taking sufficient care, the illumination obtainable may be calculated with considerable accuracy. But the fact that it was recently stated in a leading technical journal that "no one can calculate beforehand how much light will be required and how much will be obtained by any suggested arrangement," shows that the resources of modern illuminating engineering in this respect are not sufficiently widely known. The view that illumination can be pre-determined with sufficient accuracy for practicable purposes was endorsed by a number of witnesses before the Committee, representing both gas and electric lighting.

A few years ago, it would certainly have been difficult for any engineer to make these calculations without preliminary tests of the lighting units he proposed to employ. But at the present time leading companies issue polar curves of light distribution of their standard units; and it is therefore easy to calculate not only the illumination immediately under the lamp when hung at a prescribed height, but also the illumination at a given distance from it. If a lamp hung at a height h, gives a candle power I in the direction immediately below it, the resultant illumination under this lamp is I/h^2. If we next select a spot at a distance r from the point immediately below the lamp, and if the candle power in that direction is I_θ, the resultant horizontal illumination is:

$$E = \frac{I_\theta}{h^2}\cos^3\theta = \frac{I_\theta . h}{(h^2 + r^2)^{3/2}}$$

There are formulæ which are perfectly familiar to lighting engineers, and can be applied by anyone with engineering knowledge. If we are dealing with two lamps in a row we can, by using the above formula, obtain the illumination from either, at any point between them, and (by adding up) the resultant illumination due to both units.

Makers of modern lighting appliances, however, have simplified the calculations by furnishing information regarding the best relations between the height and distance apart of lamps in order to secure even illumination. Three distinctive types of distribution curves, corresponding with "extensive," "intensive," and "focusing" reflectors have been adopted; and anyone who adopts these methods can see from the data provided what the direct illumination with the lamps at a given height may be. It is true that, in practice, one cannot always adhere to these rules exactly; but, as a rule, the deviation resulting from a departure need not be large, and can, with a little trouble, be allowed for. In passing, I should like to mention that, while one can easily get full information of this kind regarding direct lighting, similar data for indirect lighting are not usually obtainable.

It will be observed that what is said above refers to the direct illumination from the lighting units, and takes no account of light reflected from walls and surroundings. It is here that less certainty is felt, although the experienced can form a very fair estimate of the added illumination, with a known type of lighting. The following rough rule, given in the American "Code on Factory Lighting," is certainly worth bearing in mind: "With modern lamps, roughly one candle power per square foot produces an effective illumination of three foot-candles when the lamps are arranged according to the uniformly distributed overhead system, with mounting heights ranging from 12 to 16 feet above the floor, and when the light is directed from the lamps to the work in an efficient manner."

The writer, as the result of tests in average interiors during recent years, has been accustomed to reckon general lighting installations on the following approximate basis. Naturally the data only apply to cases in which an even general illumination is aimed at, and typical properly designed lighting units are used. They are also subject to some modification when one is dealing with

very large or very small interiors. But they are fairly useful as a rough preliminary guide :

System of Lighting.	Specific Consumption per Lumen on Working Plane. Cub. Ft. per Hour per Ft.-Candle per Sq. Ft. Illuminated.
GAS.	
Direct—	
Low pressure	0·01 —0·02
High pressure	0·003—0·1
Indirect—	
Low pressure	0·02 —0·04
High pressure	0·005—0·02
	Watts per Ft.-Candle per Sq. Ft. Illuminated.
ELECTRICITY.	
Direct—	
Tungsten lamps	0·2 —0·3
White arc and half-watt lamps	0·1 —0·2
Flame arc	0·05 —0·1
Indirect—	
Tungsten lamps	0·4 —0·6
Arc and half-watt lamps	0·2 —0·4

In these cases the illumination referred to is that on the working plane. But it must not be inferred that the light directed on the surroundings is wasted. In many cases where the illumination of large vertical surfaces, diagrams, shelves, &c., is important, the additional illumination shed in these directions by indirect and semi-indirect systems is a compensating advantage for the relatively lower illumination, for a given energy expenditure, on the working plane. It may be observed that the proportion of the total amount of light reaching the working plane tends to increase as the area illuminated increases, assuming that lamps are kept at the same distance apart. For this reason one finds that in very extensive installations higher values of illumination are obtained than one at first sight would expect. At the other end of the scale one finds that very small interiors, with light walls, also give high results because much of the light emitted sideways is redirected on to the working plane.

GENERAL, LOCAL, AND LOCALIZED GENERAL LIGHTING.

Both in framing rules for the calculation of illumination, and in devising recommendations regarding the arrangements of lamps with respect to work, the avoidance of glare, &c., one has to draw a distinction between general and local lighting. There is no doubt that the line of demarcation between these two methods has shifted considerably during recent years. General illumination is admittedly the best system for a workroom when it is desired to illuminate the entire area of the place equally well all over. When a room is almost completely filled by rows of workers engaged on identical operations, one should clearly aim at a well-diffused flood of illumination over the working area. It was formerly the custom to treat such rooms by pendant lamps over each individual machine or group of machines, to allot so many lamps per bench, &c.; the lights provided being usually of relatively small candle power, and mounted only a few feet above the working level in the room. The development of more highly efficient gas and electric units during recent years has, however, quite changed this problem. The tendency now is undoubtedly to use more powerful lamps, if necessary, in suitably concentrating forms of reflectors, and to place them high up near the ceiling, at the same time taking full advantage of the reflecting power of light surroundings. This "overhead system" does away with all long lengths of wire or piping, and leaves the room completely clear. This system is advantageous from the standpoint of avoiding inconvenient shadows, and it has the great merit that the position of benches and machinery can be altered without it being necessary to rearrange the positions of lamps. But there still remain very many operations where a local light is needed—chiefly cases where the illumination must reach an exceptionally high value. One point in connection with local lighting may be insisted upon—the provision of a moderate general illuminant in addition to the strong local lighting, so as to avoid undue contrast between the illumination of the work and the surroundings. A general value of at least 0·5 to 1 foot-candle might be suggested. On the other hand, when general illumination is used, one must guard against too little contrast. One frequently hears it said that the eye likes to be "rested" by the gaze being transferred from the brightly illuminated work to the subdued surroundings. The physiological basis of this problem is still obscure, and requires further study.

As an instance of an industry where local lighting seems likely to be replaced by general illumination, one may take clothing factories. Here we usually find that an entire room is occupied by rows of sewing-machines doing almost identical operations; but the illumination requires to be exceptionally high, especially when dark materials are used, and local lighting has therefore been hitherto largely employed.

The varied applications of local and general lighting are well exemplified in machine shops. In an erecting shop a good general illumination is necessary as a basis. Even here, however, portable lamps may be desirable for close inspection of special work, while it would generally be agreed that lathes and benches require either local or localized general lighting. For fine work, ability to adjust the position of the light is of importance. Automatic machinery is really a special case in itself, in view of the fact that the special local illumination is really only required in setting the tool and arranging the work. Once the machine is set in operation, a moderate general illumination suffices. This illustrates the distinction between "inspective" and "detective" work drawn by the Committee.

Another circumstance that has favoured the use of general illumination for factory lighting is the simplification of machinery and the diminution of shafting and belts. Generally speaking, in machine-shops where there are a large number of moving belts and overhead shafting general lighting is inapplicable, owing to the interruption and flickering shadows caused by these moving objects; local lighting must therefore be used. The same applies to weaving rooms in textile mills, except that the method in this case might more fitly be described as localized general lighting, seeing that one light is commonly allotted to two or four looms. But here again in the very latest mills the obstruction to light from above has been diminished, and a well-diffused system of general lighting might in this case be practicable.

Points from the Discussion.

The CHAIRMAN (Mr. F. W. Goodenough) said members were much indebted to Mr. Dow for his comprehensive, interesting, and well-illustrated paper, which was rather informative than controversial; and called rather for study than for discussion. The only point he had noted for comment was Mr. Dow's query whether local or general lighting was desirable for offices, banks, and so forth. With the possibility nowadays of getting good general illumination at moderate cost, he (the Chairman) thought the desire for local illumination would largely die out. But this all depended on the intensity of application to the work that was called for, because in the case of all work demanding intense concentration of the eyes upon the work for lengthy periods—such, for instance, as the sorting of letters—the workers usually found it was restful to be able to glance up occasionally from the work on which they were engaged to a darker surrounding than the surface on which their eyes had been fixed. This they could not do if the surroundings were all illuminated to an equally high degree. He believed at the General Post Office it was found necessary, at the request of the sorters, to moderate the general lighting, in order that they might get rest for their eyes when looking up from sorting work. His own experience in office work was that he found general illumination (his office was lighted by a lamp in the ceiling) was perfectly satisfactory; and he had done away with an old desk lamp, at one time thought indispensable.

Mr. H. C. WHEAT showed a large number of lantern slides, some of which were intended to evidence that general lighting could be very effective at the working or any other plane, if proper care was taken in its installation. The question of diffusion, he said, was of paramount importance in securing satisfactory lighting; and yet it was one of the things that was most often neglected or overlooked. Mr. Dow had referred to shadows, and the direction of the light. He (Mr. Wheat) ventured to suggest that it did not matter how careful one was about placing the lights, shadows would annoy, if satisfactory diffusion was not obtained. But if good diffusion were secured, the shadow question receded more into the background. Upon the subject of local and general lighting, his own experience was that general lighting would not prove satisfactory for some classes of work—for instance, such as sewing-machines, where the upper part of the machine, with general lighting, threw a shadow on the work being done. With general lighting the shadow from the machine was insurmountable, and a serious objection. In such a case, they must have local lights.

Mr. C. C. PATERSON (National Physical Laboratory) wished to endorse nearly everything Mr. Dow had said in his paper, and also to warmly thank him for it, because it brought out various points in a very full way, which could not be put in so many words in a Government report. There were one or two things mentioned which struck him (Mr. Paterson) as points that were not always considered. The author mentioned in one place that people in America paid a good deal of attention not merely to the whitening of the walls of their factories, but to the whitening of the machines and the floors. How the whitening of floors was carried out was a most important point. It would be an easy matter to supply a minimum illumination if the floors of factories could be lighter than they usually were. This was obvious, but not always practicable. With light floors, a small illumination would suffice to make the floor look bright. But in most factories the floors were constructed of wood blocks, and were dirty and greasy; and it would be interesting to learn how in some way floors could be kept lighter. Mr. Dow briefly alluded to the question of diversity-factor. He (Mr. Paterson) was surprised at the 25 per cent. mentioned. The reason that factories sometimes looked uncomfortable and unpleasant was not because the illumination was too low, but because the variation in the degree of illumination was so great. Very bright intermittent parts due to bad distribution gave a most unsatisfactory effect. Therefore, he must say that a general low degree of illumination was much better than a high average with a great diversity factor. As to the specification of standards of lighting, the more one saw of factories, the more was one convinced that it was not very necessary to have tables of illumination standards for all different classes of work; but he thought it would be quite sufficient to divide the different kinds of work into two classes, rough and fine. In the case of fabrics, however, this was a class of work which required special consideration; and he was not sure that, if they included it in fine manufacturing operations, 3·5 foot-candles would be sufficient. It certainly would not be sufficient for working with black cloths.

Regarding indirect lighting, he thought it most desirable that they should have a little more data which would enable them to know what the diversity factor was, and what was the distribution of light in different cases—data worked out to the same accuracy as in the case of direct lighting. Indirect lighting he thought an ideal system, if it could be done at the price. Regarding the minimum of 0·25 foot-candle, it was not intended that this should be measured in the darkest place. He was acquainted with the Home Office Inspectors well enough to know that they would give the greatest possible consideration to any measurements they had to make in this connection, and they could be trusted to do the work in as practical a way as possible.

Mr. A. CUNNINGTON (L. & S. W. Railway) said he had been looking through a number of tests he had made in different goods warehouses; and he found there was no difficulty in arriving at the figure of 0·25 foot-candle as a minimum for the floor. Of course, in this he had only taken a general minimum. He had not gone into the darkest corners, but had exercised a certain amount of discretion. In the case of ordinary lighting, where there was a big row of gas-lamps down a narrow platform, he simply took the average minimum between the lamps. He found the minimum varied between 0·2 and 0·4 foot-candle. In one particular case of a large shed in an important place, there were formerly arc lamps; and the maximum was very high, and the minimum fell very low. A very wide diversity was obtained with arc lamps. This had been altered with half-watt lamps; the difference between maximum and minimum having been very much reduced. It had been suggested to him that, supposing illumination was made very uniform in a factory—supposing the illumination could be arrived at so that the illumination on the floor was really 0·25 foot-candle all over, would this not give rather a dull effect, and make the place appear inadequately lighted? He did not think that was so; for he had found a small area where the minimum illumination was 0·25 foot-candle all over—that was really the average all over—and it was not so there. He had been surprised to find how bright was the average of 0·25 foot-candle. One point mentioned by Mr. Dow was the whitening of steps; and he suggested this as a safeguard. It was; but there was also the other side, that employers would be a bit chary about. It was that, as soon as the steps had been whitened, the responsibility was accepted of keeping them white. Whitened steps soon got dirty, or the whitening was swept off. If it was proved that the steps had not been whitened when some one fell down, the responsibility would be upon the owner or occupier of the premises.

Mr. LEON GASTER also thanked Mr. Dow for the trouble he had taken in preparing the paper. It was very useful to have such an impartial view presented to them; and to have someone come along and say that the Home Office recommendations could be readily realized with both forms of modern lighting—gas and electric. As to the point Mr. Wheat raised about shadows, he (Mr. Gaster) thought that sharp shadows on floors had the one drawback that there might not be a sharp shadow where it was fancied one existed, but an actual obstruction. Shadows in factories were, in themselves, bad.

Mr. F. W. WILLCOX thought the ideal to be aimed at was to make artificial lighting so that they were unconscious of its presence—the same as in the case of daylight. He thought they had now arrived at a point which needed emphasis, and that was the incompleteness of merely taking foot-candles or any other physical measurement as the basis to determine illumination. They had to deal with an instrument, the eye, which was affected by physiological causes in some cases, and psychological causes in others, which made it function better under the same degree of illumination with one form of lighting than with another. The same intensity of lighting was not required with indirect lighting as was required with direct lighting, because the eye functioned more freely with an agreeable diffused light.

Mr. O. E. GRIGSBY pointed out that most of the data given in the report of the Departmental Committee as to existing lighting in factories were obtained with old types of lamps and old gas-jets. When they came to the new types, the conditions were all greatly improved, and values could be raised very easily.

Mrs. M. A. CLOUDESLEY BRERETON remarked that Mr. Dow had raised the question of the physiological and psychological effects of lighting. By this she was reminded of what Sir John Cockburn said at the time of the National Gas Exhibition as to the psychological effect of light. He said that light had an important stimulus not only on the body but on the mind; and when he turned on his lamps in his study, he felt the effect of their power upon him as though it were sunshine. In her experience, where factories had modern conditions of lighting, the employees were, in effect, working in sunshine; and where there was good light, the girls enjoyed better health. This was a fact that should be brought home to employers. Taking it generally that good lighting had a good physiological and psychological effect, this in itself should be an encouragement to backward factory managers in complying with the recommendations of the Home Office Committee. Besides this, increased output was something of which they had to think—even more in future than in the past. Yet another point which should be brought before factory managements was the very close co-operation there should be between builders, decorators, and illuminating engineers.

One or two other speakers followed with a few remarks; and Mr. Dow reserved his reply to the discussion, which will be communicated in writing.

COKE-OVEN MANAGERS' ASSOCIATION.

First Annual Dinner.

The First Annual Dinner of the Coke-Oven Managers' Association took place on Saturday at the Grand Hotel, Sheffield—the PRESIDENT (Mr. George Chrisp) presiding over a large company. Among those supporting the President at the head of the table were Professor W. A. Bone, F.R.S. (of the Imperial College of Science and Technology), Lieut. R. H. Montgomery (of the Ministry of Munitions), and Mr. George Blake Walker (of the Institution of Civil Engineers and the Institution of Mechanical Engineers).

After a most enjoyable repast, the Loyal Toast was duly honoured.

Mr. C. P. FINN, B.Sc., in proposing "The Army and Navy," remarked that the first dinner of the Coke-Oven Managers' Association found the nation confronted with a menace abroad—and perhaps at home—to the power of the British Empire. If it were not for the Army and Navy they would not be there that evening.

Lieut. R. H. MONTGOMERY, in responding to the toast, said it was with a sense of very real humility that he rose to thank the proposer and the assembly. In answering for the two Services, in regard to the point of the proposer that they would not have been there that evening but for the Army and Navy, he might affirm that the converse was equally true. If it were not for the coking industry and its bye-product of to-day, the Army and Navy would be useless. He felt that he was addressing a company who represented certainly the most important portion of the whole of the industrial warfare. Without them and their product, all the efforts of the Army and Navy would be utterly futile. He did not know whether the fact had ever collectively occurred to his hearers, but it had been impressed upon him very strongly that what they did in this war was practically entirely dependent upon the efforts of the members of their Association. If there was anyone in the room who had not yet realized this fact, he hoped he would bear it in mind in future. There had been numerous discussions—the question of slack for coke-ovens, &c.—and he had been told by various colliery proprietors "Oh, all our slack goes to the munition works." Attention must be concentrated for the present upon every possible means of producing high explosives. What was the use of many guns without explosives? Though this was a Coke-Oven Managers' Association—and they naturally associated coke with coal and commerce—they must look upon the mere production of coke as being a bye-product, during the period of the war at any rate. Coke was important, of course; but he hoped those in charge of coke-ovens would bear in mind that when they were dealing with their ovens the product most to be looked after at present was the benzol—that they run their ovens more with benzol in view than coke. The commercial people and others of that ilk must go by the board just for the present, and the whole of the energy be put into the question of benzol—not only for the use of this country, but for the use of our allies. He was giving away no Government secrets when he said that this country was sending thousands of tons of benzol to the allies. He, himself, of course, had benzol on the brain, and wanted everybody to have it on the brain.

The PRESIDENT, in introducing Professor Bone, said introduction was scarcely necessary, as he was well known among them, and his reputation was deservedly high because of his contributions to, and his work in, science. He was concerned in fuel economy, and his work thereby lay very close to their own. The Professor's chief popularity with coke-oven men lay in his very daring suggestion to the Government that they should restrict the output of coke from ovens and hasten the production of bye-product in the interests of the nation in the present crisis. He need scarcely say how highly the Association was honoured by the presence of Professor Bone that evening.

Professor BONE said he considered it was an unmerited honour to be called upon to propose the toast of the evening. He felt, after the very "bully" speech of their distinguished friend, the representative of the Ministry of Munitions, that it was almost superfluous for himself to make any speech at all in proposing the toast. He was, of course, not a coke-oven manager. His work lay in a direction which bore upon a good many of the problems connected with the technology of carbonization, and he could, to some extent, appreciate some of the aspects of the problems they were called upon to deal with from a technical point of view day by day. But on an occasion of this sort, and in a crisis like the present, it was not so much the technical details of the question as the broad principles of the matter that they might consider. They were all to be congratulated upon the fact that the Association was being inaugurated at this particular time. It is very important that a new industry—and it was practically new—should form an organization for the discussion not only of its own technical problems, but also of its broad economic and commercial interests. Most other branches of industry had already—and many had been in existence for long periods—associations of this kind. He thought the future coke-oven managers would look back with pride as well as with interest upon the fact that their forefathers in the industry started the Association in the year 1915, because, as his friend Lieut. Montgomery had reminded them, the industry had played, and would play, a very great part in what

they all hoped would be a favourable decision of the great war in respect not only of their own Empire, but in the interests of the civilization and liberty of the world as a whole. He ventured to think that the importance of the Association, great as it was at the present moment, would be even greater in the period which would come about after the war. The bye-product coking industry was, practically speaking, imported from the Continent; and, to give the enemy his due, he thought they must all confess they owed a great deal in this matter to German enterprise. He did not mean to say German originality, because he did not think the Germans could claim historically the origin of some of the great ideas in the industry; but they had seen the economic importance of the supersession of the old wasteful beehive oven, and had developed some of the existing systems to a high pitch of efficiency. Having done this, in their own commercial interest, they had come here and, together with organization which originated in Belgium, did much to start the industry in England. Where, asked the speaker, should we have been but for German enterprise in this particular? We had now to consider whether we could not stand on our own feet in this matter. They would not think any the worse of the German because he had convinced them of the importance of the industry; but he hoped that the future chapters of it would be retained in the future chapters of Great Britain, and that we should be able to say we never afterwards had to look to German enterprise for our own industry. If this were so, the victories of peace would be greater than the victories of war. In the future, world power would lie with that race which would combine character with high scientific attainments, and the power to apply these principles to the common things of life, which some scientific people, he was greatly afraid, were so much inclined to despise. He was convinced that the future in world power and influence would lie with the race which combined a high moral standard of character—and he believed we could really claim, with all our faults, that the standard of commercial and technical integrity was higher in this country than in any other country in the world—with the planting and development of the highest technical efficiency in the application of truly scientific principles. The future depended on gentlemen like those before him. It depended for the present on the prowess of the Army and Navy; but the Army and Navy could never do the other thing for them. It depended upon them all. And there was one thing which he believed would come out more after this struggle was over. He was not in any way suggesting that the patriotism of the Army and Navy was inferior to any other form—but he believed that the highest form of patriotism which the citizens of a nation could show was that every man would be prepared to add to the general stock of knowledge and experience that which he knew best for the good of the most, and would be prepared to sacrifice, to some extent, his own interests in so doing. The keeping back, for the selfish interests of the individual, of what he was pleased to think was some special secret, was the lowest form of conduct of which a man could be guilty. He thought that in these aims, in the past in England, we had somehow missed the mark. They were always hearing of people who were diffident of disclosing experience and knowledge for fear they should give away a secret. There were times, perhaps, if a man had some special knowledge, when by not prematurely disclosing it he could achieve a better outcome; but if he was firmly patriotic, there must come a time when he must bring that knowledge to the common stock. He hoped the Association would become a common solvent to receive the experience and knowledge which each of the members would gain, that it would attract knowledge and experience from outside by its discussions, and would become a great receiving house for the dissemination of knowledge to the interests of the whole industry. He, therefore, felt it a great honour to propose the prosperity of this infant Institution, which he firmly believed had a great future, and would have considerable influence upon the industries of the country as a whole.

The PRESIDENT, in responding, said he thought they could claim with certainty that the "baby" was going along very well, and was now able to sit up for nourishment. He sincerely thanked Professor Bone for his kind remarks about the Association. Many of the points advocated by the Professor were the very points the Association had under serious consideration, and they would welcome with great joy collaboration from the scientific institutions. They thought better opportunities for higher education should be afforded for the coke-oven manager of the future. They did not suggest that the University man would necessarily make the best coke-oven manager. The coke-oven manager was a curious blend of a chemist, an engineer, a bookkeeper, and a navvy ganger; and he did not know whether a University man would provide all these qualifications. With regard to the dinner, many people looked with some disfavour upon such social functions at the present time. He would venture to remind such people that a coke-oven manager's life was a strenuous one. He worked pretty well 24 hours a day, 365 days a year. Julius Cæsar or somebody had thrown in an extra day this year; and so the coke-oven managers were having their dinner. He would like to set forth two of the primary objects of the Association. First and foremost, the chief object was the advancement of the coke-oven industry in all or any of its branches. No matter how this was to be done, it had to go on. It was up to them all and their successors to make the thing an unqualified success, and keep the Germans out. They had to stand by another and to help each other, and to make failure success and inefficiency efficiency. If they could do this by combination and interchange of ideas and opening-out channels for the letting-out of those sources of information that they knew of, they would be doing a great good. Reverting to the status of the coke-oven manager, they wished to see this improved. They believed the time had come when they should have official recognition from the Government. The Association itself had already proved a most conspicuous success; and a great deal of the credit was due undoubtedly to the untiring work of their Hon. Secretary (Mr. Price).

Mr. G. STANLEY COOPER, in proposing "Kindred Societies," said the predominant thought in connection with this toast at the inaugural social function of the Society was one of comparison—comparison in the sense of what the Association was, and what it might be in relation to other professional institutions of a similar type. For a considerable time a number of them had been very eager to have a society of their own. They had had kind invitations by the Gas Engineers and Mining Engineers and other societies to join them; but none of these societies quite catered for the coke-oven industry. It was up to themselves to make or mar the new Association of their own. They were fortunate in having at the head of the industry a man of the academic calibre of Professor Bone. They were not, indeed, such a blackleg lot as some people seemed to think. They might have a touch of the navvy ganger about them, but there were times when they could throw it off. They were beginning to learn the scientific side of the bye-product industry, and they hoped to get men of scientific attainment to throw themselves in with them and give their help. They had in Mr. Blake Walker a representative of the early days of bye-product coking; and they were pleased to see him among them. What they wanted to do was to try and follow somewhat on the lines of other professional associations, which had their traditions to look back upon, while the coking industry had not; and they must look to the others for guidance.

Mr. GEORGE BLAKE WALKER, responding to the toast, said "science is one, but it is by no means indivisible"—in fact, it was infinitely divisible and sub-divisible. The Association had inaugurated a sub-division of science—one which was intimately connected with a whole ring of divisions of science and sub-divisions of science. There could be no doubt whatever that they were in the same position with regard to a number of other societies which were either located in their industrial neighbourhood or which were in touch with them through the Press. He would remind them that matter existed in three conditions—the solid, the liquid, and the gaseous. They had had an admirable exposition of solid advice from the previous speakers; they had had a liquid stream of fluent eloquence; and it only remained to add that volatile influence, the gas in which they were all so interested. He would like to feel that with the increasing temperature of the room the carbonization of the solid matter which had been already put before them would leave in the air some of that light effluent which contained the bye-product in the subject in which they were all so greatly concerned. Deserting the metaphorical oratory, Mr. Walker said bluntly that, so far as their industry was concerned at the present time, the trade of the country might "go to the devil;" but whatever else they had or had not, they must produce more toluol. By hook or by crook, whatever else might have to be left undone, they were to be persuaded into producing every cubic foot of gas and every ounce they could of material for high explosives. In proportion as they increased their high explosives, so much sooner would they bring to a conclusion this terrible war. In this country we were fortunately unmolested in the pursuit of our industries. France, Belgium, and Russia were not so unmolested; and so the great weight of the production of these things rested upon our shoulders. He felt sure that the right hand of fellowship would be held out by every scientific society to whom the coke-oven managers might apply for help and advice. With regard to the making common of ideas and discoveries, there was a practical difficulty which he dared say a great many of them felt, and especially some of the younger members—that our scientific equipment was very far from what one would like it to be in dealing with complex commercial questions. There were two things which anyone with an idea in his mind was uncertain about. First, had the idea occurred to anybody else and been already tried and found a failure? In the next place, the idea presented itself to an untrained mind in a shape that would perhaps not be likely to produce practical results. Therefore, it was desirable that such half-formed ideas should be referred to some body of experts who were familiar with these questions; and he would suggest that the Council of the Association might arrange, through the medium of some of the professors and specialists of the Universities or through the Societies of Engineers and Metallurgists, that there might be a Committee of reference, to whom, at suitable times and opportunities, anyone who had the germ of a new idea might go.

The speeches were pleasantly interspersed with musical and recitative contributions.

The December issue of "A Thousand-and-One Uses for Gas" (published by the British Commercial Gas Association) was a wholesale drapers' number; and in the current issue there is matter of special interest to retail drapers. The lighting and heating of shops is a subject of wide usefulness. Good lighting and good heating of interiors are of great importance, both from the customers' and the employees' point of view, even in wartime; and this means that their careful study will repay the employer. Time and money so spent will be well spent.

SWISS TESTS OF GAS-FIRES.

By Dr. E. Ott, of Zürich.

We conclude to-day [see *ante*, p. 91] a translation of the article contributed Dr. E. Ott to the "Journal für Gasbeleuchtung" of Nov. 6 and 13, giving an account of investigations carried out by him in the laboratory at the Schlieren works of the Zürich gas undertaking, on the efficiency of different types of gas-fires.

Types of Gas-Stove Investigated.

Five types of gas-stove were investigated, in some cases in two or more different sets of conditions. The types were: (1) Convection stove shown in fig. 4; (2) reflector stove shown in fig. 5; (3) gas-radiator shown in fig. 6; (4) radiation fire shown in fig. 7; and (5) the stove shown in fig. 8, which can be used either as a radiation fire or as a convection stove, according as the front doors are open or closed. The last type was tested both with the doors open and closed.

Methods of Testing.

In general the stoves were tested in the following manner: They were lighted and kept burning for one hour at the full normal rate of consumption, and some observations made in this condition. Temperature measurements and carbonic acid determinations on the flue gases were made both at the flue exit from the stove and at the point where the flue-pipe passed out of the room. In most cases these observations were repeated with the draught in the flue exit from the stove regulated to 0·004 inch of water and to 0·012 inch of water. Those stoves which were provided with an anti-down-draught device—to prevent the flames being extinguished or otherwise disturbed before the flue draught was established or by subsequent down-draught—were tested with this device first out of action and then in action. After the first hour, the stove was turned down to the reduced rate of consumption at which it was intended to work after the initial warming of the room had been done, and was kept at this reduced rate for two or three hours. The observations named above were then repeated on the stove at the reduced rate of consumption, with the flue draught at 0·004 inch of water.

Observations were made of the radiation with the stove at the full consumption and with the flue draught of 0·004 inch of water. As a matter of fact, it was not considered necessary to determine also the radiation at the reduced rate of consumption.

Observations to determine the distribution of temperature in the room were made on days when there was very little wind and with a moderate outside temperature. Readings were made on the eighteen thermometers in the positions shown by the numbers in fig. 1 [*ante*, p. 89]. Series of readings were taken both after one hour's use of the fire at full consumption, then after a further two hours' use at the reduced consumption, and again after a subsequent hour's use at the reduced consumption. The gas was then turned out and readings made at intervals of an hour, in order to observe the rate of cooling of different parts of the room.

The results of the observations indicated above are given in the original paper, from which the more important of them have been abstracted in the table below.

Comments on the Convection Stove—Type I. (Fig. 4).

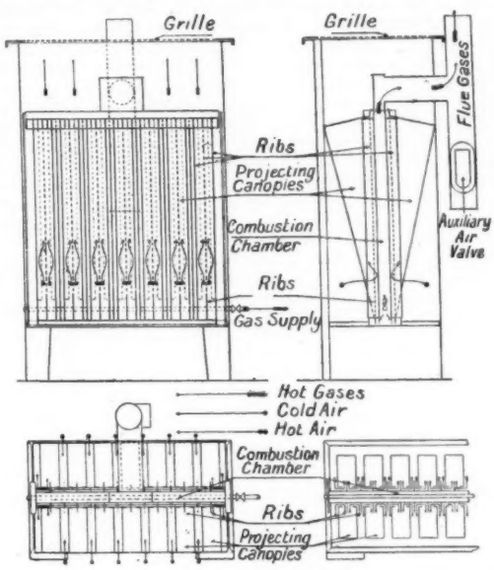


Fig. 4.—Convection Stove.

It was noteworthy that in this, as with most of the stoves, the temperature of the flue gases increased with the draught, though

Results of Testings of Five Types of Gas-Stoves, with Flue Draught at Stove Outlet of 0·004 Inch of Water.

No anti-back-draught device in action.——All rates of consumption and calorific values refer to cubic feet at 60° Fahr. 30 inches and saturated.——The net calorific value of the gas ranged from 487 to 519 B.Th.U. per cubic foot.——One volume of the gas produced on combustion from 0·480 to 0·495 volume of carbonic acid.

Type of Stove.	I. Convection Stove.	II. Reflector Stove.	III. Radiator.	IV. Radiation Fire.	V. Radiation or Convection Fire.	
					Used as Radiation Fire.	Used as Convection Stove.
Test at full consumption:—						
Rate, cubic feet per hour	26·7	26·6	27·1	27·9	27·9	27·0
B.Th.U. per hour in gas (net calorific power multiplied by rate)	13,880	13,170	14,078	14,047	14,166	13,650
Carbonic acid in hot humid flue gases, per cent.	6·5	4·8	6 15	4·9	4·4	4·2
Temperature of gases at flue vent, degrees Fahr.	280	415	300	340	426	460
,, ,, air in middle of room ,, ,,	84	70	81	75	75	72
Efficiency (utilized percentage of B.Th.U. (net) employed)	94·6	87 0	93·7	90·3	85·7	83·5
Continuation of test; consumption being reduced:—						
Rate, cubic feet per hour	16·3	14·2	13·9	15·4	13·4	13·0
B.Th.U. per hour in gas (net calorific power multiplied by rate)	8,384	7,023	7,198	7,769	6,821	6,555
Carbonic acid in hot humid flue gases, per cent.	4·0	3·1	3·5	2·85	3·1	2·45
Temperature of gases at flue vent, degrees Fahr.	232	248	250	275	376	360
,, ,, air in middle of room ,, ,,	81	66	79	73	72	68
Efficiency (utilized percentage of B Th.U. (net) employed)	93·3	89·4	91·3	87·3	82·4	78·7
Tests at full consumption:—						
Radiation measured per cent. of energy (B.Th.U. net) employed	1·48	8·61	19 68	29·14	19·19	3·65
Rise shown by thermometers in different parts of room (see fig. 1) in one hour from lighting of fire, at rate of consumption stated.						
Cubic feet per hour	26·9	27 9	27·4	27·7	27·9	27·7
Thermometer No. 1 (lampblacked) degrees Fahr.	2·9	4·1	8·3	10·3	9·0	3·8
,, ,, 2 (clear) ,, ,,	14·9	12·4	14 2	13·5	13·0	13·1
,, ,, 3 ,, ,, ,,	2·7	3·6	6·1	8·6	7·0	3·2
,, ,, 4 (lampblacked) ,, ,,	2·7	4·1	9·0	13·0	10·1	3·4
,, ,, 5 (clear) ,, ,,	15·3	12·8	13·3	13·9	14·0	13·7
,, ,, 6 ,, ,, ,,	2·3	3·1	6·1	8·5	6·8	10·8
,, ,, 7 (lampblacked) ,, ,,	2·9	6·8	9·2	16·7	13·9	4·1
,, ,, 8 (clear) ,, ,,	15·7	13·0	14·0	15·1	15·1	13·7
,, ,, 9 ,, ,, ,,	2·5	5·2	6·1	10·3	7·2	2·7
,, ,, 10 ,, ,, ,,	2·2	2·3	3·1	4·3	3·6	2·2
,, ,, 11 ,, ,, ,,	15·3	11·9	11·5	11·9	11·5	12·8
,, ,, 12 (lampblacked) ,, ,,	2·2	2·3	3·6	4·7	4·1	2·2
,, ,, 13 (clear) ,, ,,	2 0	2·2	3·1	4·1	3·6	2·0
,, ,, 14 ,, ,, ,,	15·5	11·9	11·7	12·4	11·7	12·8
,, ,, 15 (lampblacked) ,, ,,	2·2	2·3	3·8	5·2	3·6	2·0
,, ,, 16 ,, ,, ,,	2·0	2·0	3·1	4·5	3 4	2·0
,, ,, 17 (clear) ,, ,,	14·9	12·1	11·2	12·2	11·7	12·8
,, ,, 18 ,, ,, ,,	2·2	2·2	2·9	4·0	3·1	2·0

the reverse might be expected on account of more air being drawn through the flue. No escape of flue gas was found with this stove. The use of the anti-down-draught flap had very little effect on the efficiency; the reduced proportion of carbonic acid in the flue gases being balanced by a lower efflux temperature. The ventilating action is increased by the use of this device and also by increased flue draught. The differences in efficiency of this stove in different conditions are comparatively little. The total radiation was very small, being greatest at the angles 1 and 5 (see fig. 3, *ante*, p. 90), and lowest at angle 3.

This stove, being of light construction, attained its maximum heat in three-quarters of an hour; and with the gas turned off it cooled down in about the same time. The burner orifices were sufficiently close together for the flames to light one from the other. They were luminous flames, which could be seen, with difficulty only, through a lateral window. There was no smell of gas in the room when the flames were extinguished and the gas left turned on. The flue gases were free from carbon monoxide. Stopping the flue draught caused the flames, when fully turned on, to flicker; but this was easily cured by replacing the flap-valve by a simple opening. The hot surfaces of the stove, being nearly vertical, did not collect dust; and the temperature in the upper part of the stove did not exceed 300° Fahr. at full consumption or 410° Fahr. at the reduced consumption. The outer parts of the stove remained almost cold; hence the low radiation of this stove. It was built of aluminium (hence the rapid exchange of heat) and represented a very good example indeed of the type of pure convection stove.

Comments on the Reflector Stove—Type II. (Fig. 5).

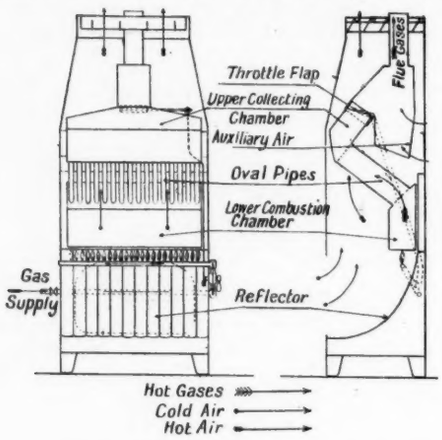


Fig. 5.—Reflector Stove.

With this stove there was escape of flue gas, which was reduced when the draught was increased; and for this reason, as well as the reasons given for the convection type of stove, the temperature of the escaping flue gases showed a notable increase as the draught was increased. The opening of the anti-down-draught device, which was an opening directly above the hot register, also caused an increase in the temperature of the flue gases. Neither the use of this device, nor reduction of the rate of consumption, nor small increase in the flue draught, had any appreciable effect on the efficiency—partly owing to the small cross-section of the flue exit causing a throttling of the flue gases. The radiation was fairly uniformly distributed; being highest at angle 2 and lowest at angle 6 (see fig. 3).

This stove, also, owing to its light construction, attained its full heat in about forty minutes after lighting; and when the gas was turned out cooled down again in less than an hour. The action of the reflector caused an increase in the radiation as compared with the convection type of stove, and, correspondingly, there was a lower temperature of the air at the breathing level. Both with the flue draught of 0·004 and 0·012 inch of water there was some escape of flue gases into the room, and a smell of gas when the flames were extinguished but the gas left turned on. This fault could be overcome by a higher position of the burners and a widening of the flue exit. The flue gases were free from carbon monoxide. The inclined oval heating tubes attained a temperature exceeding 400° Fahr. at full consumption, and exceeding 210° Fahr. at the reduced consumption; the temperature of the escaping air being in the former case 230° Fahr. All parts of the stove were readily accessible; and, though it was of light construction, it was sufficiently strong. It was a typical specimen of the reflector stove.

Comments on the Radiator—Type III. (Fig. 6).

With this type also neither the use of the anti-down-draught device, nor increase in the flue draught, nor reduction in the rate of consumption had any considerable effect upon the efficiency. The radiation was tolerably high, owing to the flames being luminous, to a reflector being used, and to the dull metal parts being at a high temperature. The radiation was fairly uniformly distributed—greatest at angles 1, 2, and 3, and lowest at angle 6 (see fig. 3). Owing to its heavy construction, the radiator took an hour to heat up to its full temperature, and more than an hour to cool down again after the gas was turned off. The effect of radiation on the thermometers was quite marked; and the temperature of the air at the breathing level was correspondingly lower. The burners, being batswing or slit burners, could be turned down as desired.

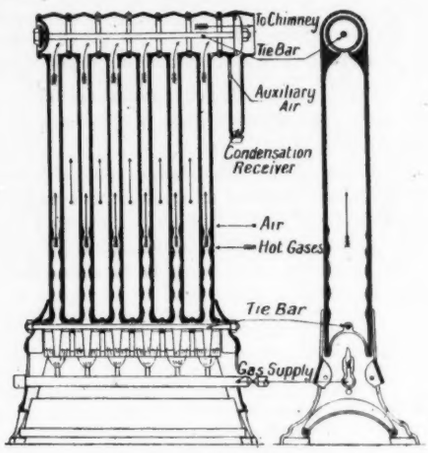


Fig. 6.—Radiator Stove.

With the anti-down-draught device open, no appreciable escape of flue gases took place. Interruption of the flue draught when the burners were turned full on caused a tendency to smoke, and to the formation of carbonic oxide; but with the flue fully open the flue gases were free from the latter. At full consumption the temperature of the lower communication tube much exceeded 570° Fahr.; that of the upper communication tube was about 210° Fahr. At the reduced consumption the corresponding temperatures were about 446° and 185° Fahr. The temperature of the air between the columns of the radiator when at full consumption was about 194° Fahr., and the air directly above the radiator about 176° Fahr. The hot surfaces, being vertical and easily accessible, could be readily kept clean. The radiator was solidly constructed of cast iron, and intended for office use, &c. In virtue of its good radiation and convection results, it constituted a good intermediate type between the radiation and the convection stoves.

Comments on the Radiation Fire—Type IV. (Fig. 7).

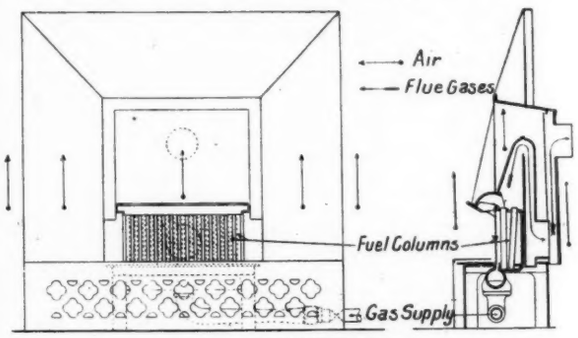


Fig. 7.—Radiation Fire.

This fire had no anti-down-draught device. Reduction of the rate of consumption greatly affected its efficiency owing to the bad transmission of heat through the heavily constructed stove. The difference in efficiency at the flue outlet and at the outlet of the flue pipe from the room was very considerable with this type, owing to the high temperature of the flue gases at the flue exit from the fire. The radiation, amounting to 29·14 per cent. of the heat applied, was highest at angles 3 and 4, and lowest at angle 1 (see fig. 3). The upright fuel columns gave the highest radiation in a horizontal direction. This fire also, on account of its heavy construction, needed about an hour to attain its full temperature, and about an hour to cool again after the gas was turned off. The effect of the radiant heat on the thermometers was naturally large. The burners being of the atmospheric type, the rate of gas consumption could not be greatly reduced without risk of the flames striking-back. There was no device for regulating the air supply to the burners. The flames lit one from the other. Flue gas escaped into the room, especially before the fire had got fully hot, both at 0·004 and 0·012 inch draught in the flue, as shown by the fact that the proportion of carbonic acid was 15 parts per 10,000 in the air of the room, and 100 parts per 10,000 immediately in front of the fire, at the full rate of consumption. With the flue unobstructed there was no carbonic oxide in the flue gases. Down-draught in the chimney did not extinguish or affect the flames to any appreciable extent. Some parts of the stove were very hot; the air above the centre of the back-plate was above 480° Fahr.

at the full rate of consumption; and at the reduced rate, above 300° Fahr. The surfaces of the stove, being nearly vertical, collected little dust. The stove was of solid construction, and the fuel columns were not brittle. It was typical of a true radiation gas-fire.

Comments on the Radiation or Convection Stove—Type V. (Fig. 8).

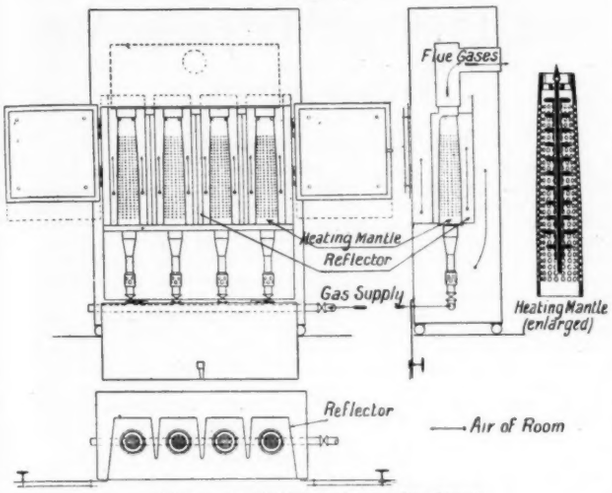


Fig. 8.—Radiation or Convection Stove.

This stove was provided with doors or hinged flaps to admit of it being used either as a radiation or convection stove. These doors, for the purposes of these investigations, were extended downwards, as shown by the dotted lines. The investigations on this fire were made both with the doors open, in which condition radiation had full play, and with the doors closed, which converted it into a convection stove. The investigations with this type were made with a view to following the distribution of temperature with strong and with reduced radiation with the same stove; and the results are not in some respects comparable with the figures obtained for the other types. Owing to considerable escape of flue gas, the efficiency also could be only determined approximately; and in this respect also the figures are not comparable with those for the other types. There was no anti-down-draught device.

With the doors open, the temperature of the flue gases at the flue vent was very high; and hence the efficiency appears low. Reduction of the rate of consumption greatly affected efficiency. The radiation, amounting in all to 19·19 per cent., was greatest at angles 3 and 4, and lowest at angle 1 (see fig. 3). The stove attained its full heat in about fifty minutes, and after the gas had been turned off took about the same time to cool down. The four burners, being wide apart, did not light one from the other. The burners were of the Mèker type, and could therefore be turned down without striking-back. They were provided with air regulators. There was considerable escape of the flue gas into the room; the proportion of carbonic acid in the air in the neighbourhood of the fuel columns being 100 volumes per 10,000, even at the reduced consumption, and in the air of the room 25 volumes per 10,000 at full consumption, and 15 volumes per 10,000 at the reduced consumption. The flue vent ought therefore to be greatly improved. Carbonic oxide was not detected, and the flame burned steadily, even when the flue draught was checked. The temperature of the metal at the flue exit was nearly 570° Fahr. at full consumption, and 390° Fahr. at the reduced consumption.

With the doors shut the efficiency was lower than with them open. The total radiation was reduced to 3·65 per cent.—being highest at angle 1 and lowest at angle 4. The bad efficiency appears to be due partly to increased flue-gas temperatures, owing to less cooling by air, and partly to a lower proportion of air in the flue gases, which was probably caused by the escape of carbonic acid into the room being greater than when the doors were open. The stove was pretty and light, though of sufficiently heavy construction. The escape of flue gases into the room could probably be avoided by shortening the columns of fuel and enlarging the flue vents. The stove might be converted into a good combination of the radiation and convection stove. A later type of the stove, however, gave substantialiy the same results.

Conclusion.

It may be pointed out that the figures for the rate of cooling of the rooms showed clearly that rise of temperature in which radiation has played a considerable part falls away much more slowly after the gas is turned off than corresponding rises of temperature produced chiefly by convection. This is due not merely to the heavier construction of the radiation fires, but to the higher floor and wall temperatures, and is specially noticeable in the experiments on the fifth type of stove, with which the temperatures produced when it was used as a radiation fire fell off much more slowly than when it was used as a convection stove.

The more a stove heats by radiation the more rapidly ensues the feeling of warmth from it, and the more slowly does the temperature fall after it is turned out. Though good radiation produces considerably higher floor temperatures in the neighbourhood of the fire than convection, there is no considerable reduction in the temperature at the breathing level. Moreover, a radiation fire with a smaller efficiency heats more rationally than a convection stove with a higher efficiency, owing to the more favourable distribution of temperature. With a very large fire, the radiation in its vicinity becomes troublesome, and it therefore follows that the scope of the two chief types may be stated as follows: The radiation fire is more suitable for small rooms, or rooms which have to be heated only occasionally, while the convection stove is more suitable for large rooms or for continuous heating. There naturally will be many transitions; and taste plays a large part in the selection.

The efficiency of the fires, with the exception of Type V., both at full and reduced consumption, with the flue draught of 0·004 inch, generally exceeded 90 per cent. at the flue-vent, and always exceeded 90 per cent. at the exit of the flue-pipe from the room. Any endeavours to utilize the heat of the flue-pipe to secure this higher efficiency are not of much value, as often only very short flue pipes can be used. Further increase of efficiency would involve risk of condensation of water from the flue gases, and special arrangements would have to be made for removing the condensed water. The anti-down-draught devices used with certain types of stove did not reduce the efficiency to any considerable extent, while they increased the ventilation.

Some attention should be given to the better removal of the flue gases in the radiation type of fire, although the proportion of carbonic acid found in the air never reached a dangerous figure. Even in experiments without connection to a chimney, the proportion of carbonic acid in the middle of the room never exceeded 40 parts per 10,000 during the first hour at full consumption, or 30 parts per 10,000 during subsequent heating at reduced consumption; whereas even 100 volumes of carbonic acid per 10,000 are not injurious to health. One hour after the gas had been turned off the proportion of carbonic acid had again fallen to 10 volumes per 10,000. These observations support the oft-repeated contention that a certain equilibrium in the composition of the air becomes established in closed rooms owing to the renewal of the air through walls and cracks. No stove, even with the flue cut off, produced carbonic oxide in such a proportion that it rendered the air of the room injurious to health.

Finally, the satisfactory behaviour of a well-constructed gas-stove is also largely dependent on its being chosen of a suitable size for the size of the room and the temperature required, as well as on its being properly fitted and looked after.

INDUSTRIAL GAS: ITS SERVICES TO THE NATION.

Mr. H. M. Thornton's Lecture at Derby.

In last week's issue—pp. 81-5—we gave the principal portions of the interesting lecture that Mr. H. M. Thornton, the Managing Director of the Richmond Gas Stove and Meter Company, delivered the previous night at a meeting of the Derby Society of Engineers. Mr. Thornton concluded his remarks with these words: I do not claim to have shown all the ways in which gas has served us in war time—the illustrations given are doubtless only representative of a greater number that will become known when the time comes to write the history of this country's remarkable effort to cope with the wholly sudden and absolutely unexpected demand for munitions of war. I hope, however, I have said sufficient to explain the gratification which is felt by the gas industry at large at the prominence it has been able to attain in the hour of the nation's need.

Mr. J. Ferguson Bell, M.Inst.C.E., the Engineer and Manager of the Derby Gas Company (who presided), in introducing the lecturer, said that one outcome of the war was that, in engineering processes, old methods had been compelled to give place to new, and that engineers now found it necessary to look at matters from a new standpoint. The tendency among manufacturers to continue without changing their methods, and the reluctance to adopt new processes, had allowed Germany to take the lead in far too many directions; but the eyes of Englishmen were now opened, and one result of the war would undoubtedly be a renaissance of British industry. The adoption of new processes not only meant reduction in costs, and greater variety in output, but an extension of markets which would doubtless be found in the near future. The lecturer would, he said, give an account of some of the new methods which had been adopted for "heat-treatment" processes, and indicate the extent to which gaseous fuel was now utilized in this country. The Richmond Gas Stove and Meter Company, of which Mr. Thornton was the Managing Director, had paid special attention to the application of gas to various industries. As had been pointed out upon several previous occasions, the present methods of using coal entailed great waste; and this waste in turn involved the waste of many of the bye-products of coal of which England now stood in great need. Both picric acid and trinitrotoluene—supplies of which largely depended on coal distillation—were essential commodities in this time of war; and it was of the greatest importance that coal for industrial purposes should be used in such a manner as would ensure the largest output of these

products. The lecturer would show how these products could be made available for national use, and also how the manufacturer himself would benefit by the adoption of gaseous fuel in his industry. In conclusion, Mr. Bell heartily welcomed Mr. Thornton, and mentioned the previous lectures he had delivered, with the object of bringing before the manufacturers of the country the importance of gas as an industrial fuel.

The lecture, which was fully illustrated by about sixty lantern slides, aroused much interest. Several members took part in an informal discussion which followed; and, after Mr. Thornton had answered the various questions put to him, the meeting concluded with a hearty vote of thanks to the lecturer.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Ehrich and Graetz Lamps for High Pressures.

SIR,—As a matter of interest to gas engineers and gas users who may have observed the publication of the specifications of British patent applications No. 16,132 of 1914 and No. 23,174 of 1914, of Messrs. Ehrich and Graetz, of Berlin, purporting to refer to incandescent gas-lamps such as are covered by our prior patent, No. 1348 of 1912, we think it desirable, having regard to our own patents, to point out that the publication of the specifications is not to be regarded as an indication that the applications in question will mature into letters patent.

As it happens, opposition to both applications has been entered by us with a view ultimately to stopping the grant of letters patent, although in accordance with the procedure to be followed under Rules 2 and 3 of the "Patents, Designs, and Trade Marks (Temporary) Rules, 1914," all further proceedings in the matter of the oppositions will be suspended until the end of the war.

In any event, it is not to be expected that lamps constructed as described in the specifications of the opposed applications will be put on the market even after the war, if we are correct in believing, as our Counsel advise us, that the constructions in question are dominated by our patents.

JAMES KEITH AND BLACKMAN CO., LIMITED,
per G. KEITH, Assistant Managing Director.

27, *Farringdon Avenue, E.C., Jan.* 14, 1916.

Trade Teachings in School Questions.

SIR,—My attention has been called to the paragraph with the above heading in your issue of Jan. 11, taking exception to a question of arithmetic set for the students in one of our branches, respecting the comparative cost of gas lighting and electricity as lighting mediums.

I should like to point out that this question was not devised by the College, but is incorporated in the College "Text-Book on Arithmetic," as being a question set by the Civil Service Examiners at an open competitive examination for female sorter candidates.

ERNEST G. V. CLARK, Vice-Principal of Clark's College.

Chancery Lane, W.C., Jan. 13, 1916.

Increased Toluol Production.

SIR,—Under the above heading, in your issue of Dec. 21, Mr. B. Dunglinson deals with the "Effect of Liming Coal" and "Experiments on the Yield of Benzene and Homologues."

If 2 per cent. of finely-divided limestone is intimately mixed with coal before carbonizing, and the resultant coke is quenched out of contact with air, no particles of lime will be visible. If, however, the incandescent coke is allowed air-contact, sufficient to burn the surface carbon, fine pieces of shale or lime will show. This mottled appearance has ever been an intermittent source of trouble on many coke-oven plants, and is always due to ineffective quenching.

It is suggested by Mr. Dunglinson to: (1) Well moisten the coal with spent ammoniacal liquor; (2) carbonize at a low temperature—making 7000 to 8000 cubic feet of gas per ton of coal. Against any such method, there are the following objections: (1) Moisture reduces the temperature of the retort and prevents the formation of aromatics until evaporation is practically finished. In consequence, one of Mr. Dunglinson's experimental conclusions must be inaccurate. (2) To carbonize for a yield of 8000 cubic feet of gas per ton of coal would seriously affect economical production: (*a*) The initial coal cost would increase 50 per cent.; (*b*) the working cost would be increased; (*c*) works now producing to their capacity would have to make extensions equal to half their present plant; (*d*) the scheme could not be profit-bearing.

It is unfortunate that Mr. Dunglinson does not give in his letter last Tuesday the actual yields of bye-products recovered or recoverable during the limestone experiments which he quotes as being made at coke-ovens; also the class of coal used. The difference in the two results of toluene per ton of coal has a natural explanation—the 6 lbs. being from Lancashire coal and the 4·51 lbs. from Derbyshire coal.

The figures given as to the increase in the ash content of the coke as being obtained at the Birmingham experimental plant do not carry conviction, as calculation proves the inaccuracy of analysis or a difference in the coal. If 1·91 per cent. of calcium carbonate be added to coal which produces 65 per cent. of coke residuum, the result would be $\frac{56 \times 1{\cdot}91}{65} = 1{\cdot}65$ per cent. of CaO in the coke. Allowing for the increase in sulphur, the total increase of ash would be 1·74 per cent. The difference to be accounted for is thus 2·5 per cent. Most modern coke-oven plants could allow for 2 per cent. of ash in the coke, and still be within the usual allowance of 10 per cent.

Beeston, Nottingham, Jan. 15, 1916. ROBERT W. PRESTON.

"Bye-Products of Carbonization"—Errata.

SIR,—Referring to my article, under the above heading, "collecting in 5 c.c. fractions" should read "collecting in 5° C. fractions." The yield of toluol from a crude 65's benzol, should be 12·5 per cent., not 25 per cent., as stated.

Jan. 15, 1916. B. DUNGLINSON.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

Municipal Expenditure (Scotland).

Mr. CURRIE asked whether the Government had indicated to any of the municipal authorities in Scotland who were at present engaged upon schemes for the acquisition of gas undertakings, or similar public utility schemes, that they will not be allowed to raise capital by borrowing for such purposes; and whether processes of arbitration in connection with such schemes are to proceed now or are to be indefinitely postponed, in view of the claims of recruiting on the already depleted staffs of municipalities and other staffs affected?

Mr. M'KINNON WOOD (the Secretary for Scotland) replied that sanction to raise loans for the acquisition of gas undertakings by Scottish local authorities had been refused in several cases during the past year. It was undesirable that local authorities should enter into commitments of the kind—including arbitration proceedings—at the present time. The expediency of suspending arbitration proceedings already in progress must depend upon circumstances.

Lighting of Railway Trains.

Mr. BOWERMAN asked the President of the Board of Trade whether, arising out of recent railway accidents involving the firing of carriages and consequent additional loss of life, representations had been made to the various railway companies suggesting the lighting of trains by electricity in place of gas; and, if such representations had been made, whether he would state the nature of the replies received?

Mr. PRETYMAN said that the Board of Trade had been in frequent correspondence with the railway companies on this subject, and they had recently asked the companies to consider what further steps they could take to accelerate the change from gas to electricity on main line and express services. The replies received showed that the companies generally have made considerable progress in effecting this change, but that the work had been interfered with owing to shortage of labour and material and other conditions caused by the war. The Board of Trade were fully alive to the importance of this matter, and it would continue to receive their careful attention.

Donations and Excess Profits Tax.

Sir J. D. REES asked the Chancellor of the Exchequer whether donations for patriotic purposes were allowed as deductions in excess profits?

Mr. M'KENNA; The answer to the question is in the negative.

Coal Supply (West Riding of Yorkshire).

Mr. SHERWELL on Monday last week asked the President of the Board of Trade if he was aware that the action of the Government in interfering with the supply of coal to manufacturing industries in the West Riding of Yorkshire was greatly accentuating the scarcity of coal already due to the shortage of mine labour and the lack of adequate facilities for railway transport, and that unless immediate steps were taken to remove, or to modify, the Government regulations, many important industries engaged on Government and export work would be compelled to close down, and large numbers of workers thrown out of employment? Was he also aware that in the West Riding of Yorkshire coalowners were being instructed to withhold the supply for the execution of their coal contracts in the interests of the manufacture of coke and the residuals of coal?

Mr. RUNCIMAN, in reply, said that if Mr. Sherwell would furnish him with particulars of the cases he had in mind, he would look into the matter. The Board of Trade had on particular occasions requested coalowners to give a preference to public utility undertakings and munition works, and they had called general attention to the necessity of maintaining adequate supplies to bye-product coke-ovens; but he was not aware of any regulations such as Mr. Sherwell had suggested.

Mr. BOOTH asked Mr. Runciman whether he was not aware that the Government were pressing manufacturers of coke very strongly for the need of benzol, and there was a great deal of difficulty in obtaining the slack to keep ovens going and so producing the bye-products indispensable for high explosives?

Mr. RUNCIMAN remarked this was the ground on which some communications had been sent out by the Board of Trade to some districts. The necessity of bye-products from some sorts of coal, of course, was always present to his mind.

Newmarket Public Lighting Contract.—On behalf of the Directors of the Newmarket Gas Company, Mr. J. H. Troughton (the Manager and Secretary) has written to the Urban District Council declining an offer of 7s. 6d. per lamp for the present lighting year, *plus* payment of the current price for all gas consumed. He points out that last year, when two-thirds of the full amount of gas was consumed, the Council paid for it, and also paid £136 as compensation for failing to take the remaining one-third. If no gas was used this year, the compensation should be at the same proportionate rate, or three times the amount paid last year. When the letter came before the Council at their last meeting, one or two members seemed to think the Company were rejecting a generous offer. It was, however, agreed that the matter should be discussed in committee.

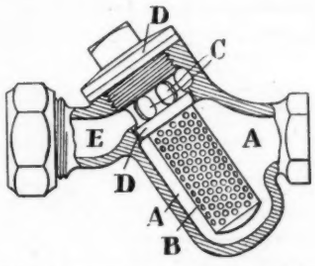
REGISTER OF PATENTS.

Strainers for Water-Meters.

WATSON, F. M., of Rotherham.

No. 24,172; Dec. 16, 1914.

This invention has for its object to provide water-meters with filters or strainers at their inlets, which can be removed for cleaning or other purpose without having to disconnect the service pipe or meter.



Watson's Water-Meter Filter or Strainer.

The illustration shows the invention applied to one of two types of meters for which it is specially suited.

A is a chamber (attachable to the meter), to receive the filter or strainer B. It is here shown as a separable attachment, but may be cast in one with the body of the meter. The water enters the filter by the openings C, and foreign substances are retained in the strainer, as they are not able to escape through the small perforations in it. The foreign substances are, by the collar D, prevented from passing through from E into the chamber A—the collar being a sliding fit in the flange, or reduced portion, of the chamber A, as shown.

Treating Coal to Obtain, Oils, Ammonia, and Other Products.

BERGIUS, F., of Hanover.

No. 18,232; Aug. 1, 1914. Convention date, Aug. 8, 1913.

This invention consists in subjecting coal to the action of hydrogen at pressures above 10 atmospheres, and preferably exceeding 100 atmospheres, and at an elevated temperature less than 600° C. In these conditions the hydrogen, it is said, reacts directly with the coal, which is transformed without destructive distillation (and substantially without formation of uncondensable gases) into hydrocarbons which are either liquid at ordinary temperatures and pressures or which have a low melting point. The working temperature is preferably between 300° and 500° C.

The invention does not, the patentee remarks, consist broadly in the hydrogen treatment of solid carbonaceous material but only in the special kind of such treatment under the heat and pressure conditions mentioned for the purpose of transforming the solid carbonaceous matter directly into liquid or easily fusible hydrocarbon compounds. In particular, it is essential to employ a temperature of at least 10 atmospheres—very much higher pressures being preferably used. It is advisable, he says, to work in the presence of a solvent for the products formed during reaction; a suitable diluting medium being petrolium distillates. The nitrogen of the coal is obtained in the form of ammonia in the reaction vessel.

This hydrogenation may be combined with a carbonization process by subjecting wood or peat or other vegetable matter to heat treatment in a hydrogen containing atmosphere at high pressure—the hydrogen being supplied from a source different from the wood, peat, &c., under treatment; the working conditions being such that not more than very small quantities of hydrogen which are absolutely insufficient for the hydrogenation aimed at could be formed from the wood, peat, &c., under reaction.

The products produced in the hydrogenation process consist mainly of hydrocarbons having different boiling points, and which chemically resemble mineral-oil hydrocarbons. By far the greater part of these substances is liquid at an ordinary temperature; but the ash of the coal remains in the vessel as solid residues. The nitrogen of the coal escapes as ammonia with the hydrocarbons which have been distilled. The separation of the resulting condensed products can be effected in the usual manner by fractional distillation.

Condensing, Scrubbing and Washing Apparatus.

POOLEY, H., and FIDDES, G. B., of Leicester.

No. 24,598; Dec. 24, 1914.

This invention relates to apparatus for removing tar, dust, and other impurities from gases, or for absorbing any of the constituents of coal or other gases—such, for instance, as benzol or toluene.

Fig. 1 is a vertical section of the apparatus. Fig. 2 is a cross section. Fig. 3 shows in vertical section (drawn to a larger scale) a portion of one side of the apparatus.

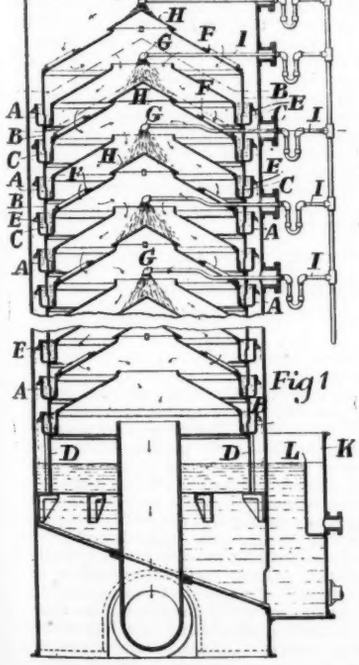
The outer casing is of cylindrical formation, vertically disposed, and contains baffle-plates of conical formation, superimposed in nest fashion—sufficient space being left between the plates for the free passage of the gas. Alternate plates have central openings and the intermediate plates have holes near their peripheries, so that the gas, as it passes vertically downwards, is caused to impinge upon the surface of the plates and follow a zig-zag course in order to pass through the holes and openings, the arrangement of which is staggered. At the peripheries of the baffle-plates a liquid seal prevents any escape of the gas from between the plates.

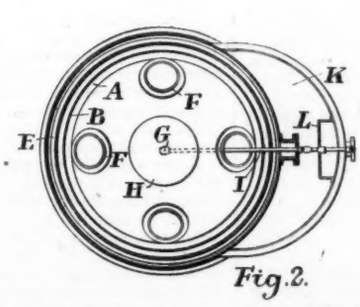
In conjunction with each baffle-plate there is a gutter or channel A to collect and carry away the liquid and impurities—the gutters forming the liquid seal between the baffle-plates so as to prevent the escape of the gas, but will admit of the escape of the tar and other impurities. The impurities separated from the gas are carried away from the plates independently—that is to say, the impurities do not drop from one plate to another, so that to a very great extent clogging of the plates is avoided.

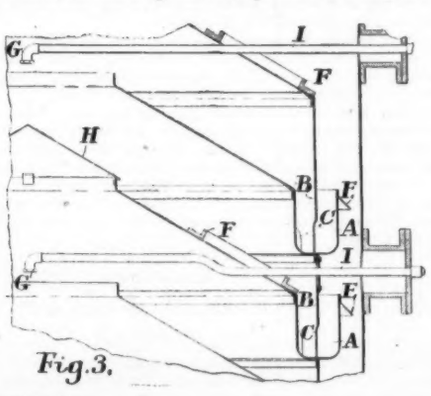
Each baffle-plate has depending from its edge, or from the gutter on it, a flange or cylindrical plate B, the lower edge of which is gapped at intervals or has formed in it apertures or bridge-like openings C. The lowermost plate is furnished with a deeper and ungapped flange D, resting on brackets in the interior of the shell, or else upon a platform or joists extending across the bottom part of the apparatus. The openings C are less in height than the depth of the gutters A, so that when the latter are full of liquid a seal will be formed to prevent the escape of gas from the inside to the outside of the flanges; but the openings allow liquid to pass.

The outer side of each gutter is provided with an outwardly extending lip or apron E, to prevent the liquid as it overflows and drops from the gutter of one plate falling into the gutter of the plate underneath. The lip, in the form of an annular ring or flange and by preference downwardly inclined, terminates in an edge which stands away from the side of the gutter to allow the extracted matters to fall. But to prevent the impurities falling from one baffle-plate to another, the holes F are surrounded by an upstanding lip or flange, attached to the baffle-plate.

Employed in conjunction with the plates is a nozzle G, to spray water, steam, or other solvent or cleansing agent over the baffle-plates, carry off the impurities separated from the gas, and to a certain extent serve for washing the gas as it passes through the apparatus. The nozzles preferably direct the spray upon the caps H of the plates so that as the gas passes through the central opening in one plate it will, as it impinges upon the apex of the cone underneath, also come into contact with the sprayed liquid. To this end each nozzle is supplied by a pipe I (leading from a main connected with the source of supply) fitted with a syphon to form a seal against back-pressure of the gas.







Pooley and Fiddes' Condensing, Scrubbing, and Washing Plant.

The case has at the upper end a gas inlet J (preferably but not necessarily centrally disposed) and at the bottom a tank K, the floor of which is downwardly inclined towards an overflow L and outlet for the liquid. The lower extremity of the flange D on the bottom baffle-plate extends into the tank and below the level of the water in it, and so forms a liquid seal to prevent escape of the gas round bottom end.

In operation, water or other cleansing agent is sprayed upon the baffle-plates, and the gas, on its passage down between the outside of the baffle-plates and the inside of the shell, is checked by the water-seal at the bottom; so that it is compelled to find its way through the holes in the uppermost baffle-plate and then on downwards between the whole vertical series of baffles, "during which, by impinging upon the different surfaces and contact with the cleansing agent, the impurities or constituents are separated from the gas and removed from the independent plates in company with the liquid—the gas passing down through the plates while the liquid and impurities or otherwise fall down on the outside thereof." The lighter impurities overflow with the liquid at L from the tank and pass away. The heavier impurities fall to the bottom of the tank, and, owing to the inclination of its floor, collect at one side, to which access may be had through the top for the removal of such residue when necessary.

The apparatus described is claimed to be especially advantageous in that it is easy to clean by the removal of the baffle-plates one after another; while water, steam, or other agent may be used at will, tar and heavy deposits are easily removable from the tank, and each baffle-plate acts independently of the other as regards discharging the impurities separated from the gas.

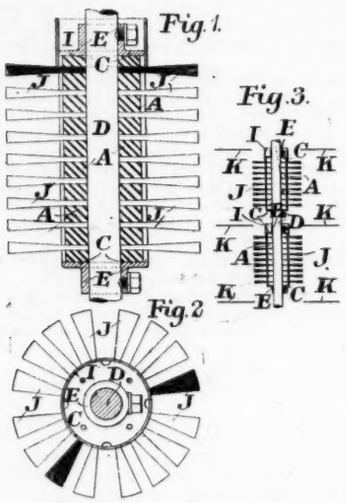
Purifying Gas.

CLIMIE, W., JUN., of Glasgow.

No. 1045; Jan. 22, 1915.

This invention particularly relates to the scrubber for washing gas and extracting tar as described in patent No. 11,136 of 1914, where the washing medium passes down through a series of perforated plates arranged in the scrubber, which is also fitted with a shaft having blade-carrying arms or rotary discs.

According to the suggested improvement, brush devices, consisting of blocks having fibre, wire, or other suitable material inserted into them and carried between discs secured to the central shaft, are arranged in place of the blade-carrying arms or rotary discs in the interior of the scrubber, so as to act as a gas forcing and mixing medium. The diameter of the central hole in each perforated plate of the series of plates arranged in the apparatus is preferably not less than the overall diameter of the brush devices, so that the central shaft can be raised out of the scrubber for examination, cleaning, &c., without removing the perforated plates.



Climie's Gas Purifying Apparatus.

Fig. 1 is a sectional elevation of one of the brush devices fitted to the shaft of the scrubber; fig. 2 is a plan; fig. 3 is a similar view to fig. 1 (to a smaller scale) showing a number of brush devices arranged between the discs of the scrubber.

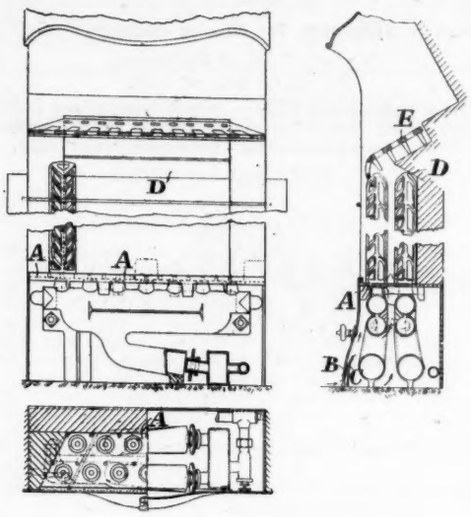
Each brush device consists of a number of blocks A, preferably of wood, secured between discs C carried by the shaft D. The discs, formed with bosses E, are secured to the shaft, and the blocks are arranged equidistantly round the shaft; bands G being arranged to encircle them so as to retain them in position. The bands (secured to the blocks) extend upwards beyond the upper face of the upper disc C so as to form a well I. Fibre, wire, or other material J is secured in the outer surfaces of the blocks, so that each block with its fibre forms a brush; while the series of brushes arranged between the discs K (fig. 3) form a brush device. Grooves are formed between the meeting faces of the blocks, so as to conduct the liquor to the lower brush part of the blocks.

Gas-Fires.

GRAFTON, W., of Glasgow.

No. 8986; June 18, 1915.

This invention has for its primary object to provide a gas-stove such as "to ensure perfect combustion with more complete utilization of the heat due to combustion, and to obtain regenerative effect consequent upon the preheating of the mixture of gas and primary air and part of the secondary air supply, and to ensure silence during the process of combustion."



Grafton's Gas-Fire.

The gas-fire shown is furnished with two separate bunsen tubes, each tube provided with upwardly projecting nozzles—arranged in staggered relationship. Above the burner tubes is a metallic grid A or plate apertured for partial penetration by the nozzles, with clearance for the passage of some small volume of preheated secondary air. The plate is a conductor of heat, and is formed with depending ribs resting on the burner tubes "so as to establish thermal connection between the burner tubes, which are otherwise entirely separate from one another." The upper face of the plate is formed with upstanding lugs to maintain the radiants in position. The arrangement is "such that the radiants completely fill up the front of the fire; the entire surface visible from the front constituting a combustion chamber and heat-radiating surface." The lowest part of the fire is closed against ingress of air, save what enters through an opening B at the fret front or side—such opening being "of a determinate area calculated as the result of experiment for each standard form to ensure that the gaseous mixture passing through the nozzles is explosive." The air (chiefly primary air, with some secondary air) passing through the opening must flow in the direction indicated by the arrows to secure recuperation, past a baffle C, through, around, and between the burner tubes, which themselves become heated partly by radiation and partly by conduction. A supplemental supply of secondary air will also pass direct to the radiants from the place in which the fire is used; "but such supplemental supply is not under control, as distinguished from that passing through the opening B."

In order to confine the passage of the gaseous products before passing to the chimney, the back brick is formed with a shoulder D or an abrupt projecting brick at or about right angles to the plane of the back brick and surmounting the back radiants—the extreme ends of the shoulder being formed in one with the side bricks, or resting on the side bricks; the upper face of the shoulder being inclined and surmounted by a top radiant E. The shoulder forms a dam for the hot currents rising in the shallow chamber containing the radiants; "the arrangement being such that during the combustion of the gas the bricks are rendered red hot, whereby the heat of combustion is husbanded, the bricks constituting a thermal storage from which and the top radiant heat rays are projected into the room."

The patentee concludes his specification thus: "As is evident, the lower face of the shoulder is adapted to be heated by the gaseous products from the rearward radiants, and the inclined upper face of the shoulder is adapted to be swept and heated by the gaseous products from both rows of upright radiants, while it also serves as a reflector in respect of the top radiant. In these respects the shoulder provided in my construction performs a function quite distinct from that of an inclined fire-back as heretofore provided."

Trinitrotoluene Manufacture.

ROBERTS, D. C., and STUART, O., of Liverpool.

No. 7047; May 11, 1915.

This invention relates to a method of recrystallizing trinitrotoluene with the object of purifying the crude product so as to obtain a product having the right melting point, which, as at present prescribed by the Government specification, is 80° to 81·5° C. The proposal is to employ ordinary commercial mononitrotoluene—*i.e.*, the product which can be obtained by the mono-nitration of toluene consisting (for instance) in a mixture of 42 per cent. of the para-isomer, 55 per cent. of the ortho-isomer, and 3 per cent. of the meta-isomer.

As an example, the patentees say 2000 lbs. of crude trinitrotoluene are heated with 750 lbs. of ordinary commercial mononitrotoluene at 80° C. The solution is filtered and cooled to a temperature not below 16° C., so that the lower nitration products will not crystallize out. When the crystallization is complete, the mother liquor is separated from the crystals by a centrifugal or press, and the crystals are rinsed with a small quantity of cold alcohol—preferably not absolute alcohol, but aqueous alcohol, containing 40 per cent. of alcohol and 60 per cent. of water. The use of this mixture obviates the risk of dangerous fires.

The product is of a light colour, and has a melting point of 80° to 81·5° C. A yield of 90 to 95 parts of pure trinitrotoluene is obtained from every 100 parts of crude trinitrotoluene. The nitrotoluene remaining in solution can be at all events partially renitrated.

If the same solvent has been employed repeatedly, care must be taken in renitration, since it has been found that there is a tendency towards an accumulation of the dangerous nitrobenzoic acid and azo compounds which remain in the mother liquor each time if they are present in the crude trinitrotoluene. These difficulties can be avoided, however, if the solvent is purified by distillation in steam—thus giving a pure product, which may be used for renitration or recrystallizing.

Trinitrotoluene Manufacture.

ROBERTS, D. C., and STUART, O., of Liverpool.

No. 9466; June 29, 1915.

This invention relates to an improved method of recrystallizing trinitrotoluene, with the object of obtaining a pure product, having the right melting point—that at present given in Government specifications being 80° to 81·5° C.

The patentees suggest that 2000 lbs. of crude trinitrotoluene should be heated with 750 lbs. of nitro-benzene at 70° C.; and the solution filtered and cooled to approximately atmospheric temperature. When the crystallization is complete, the mother liquor is separated from the crystals by a centrifugal or press, and the crystals are rinsed with a small quantity of cold alcohol—preferably aqueous alcohol containing 40 per cent. of alcohol and 60 per cent. of water. The use of this mixture is said to obviate the risk of dangerous fires. The product is of a light colour, and has a melting point of 80° to 81·5° C. The nitrobenzene is purified by distillation in steam, and can then be used again as solvent in a fresh recrystallization.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Jan. 12.]

For convenience of reference, the applications are now arranged alphabetically under the names of the applicants and communicators; the latter being printed in italic type. In the case of joint applicants or communicators, each name is given independently. A new number will be given when the complete specification is accepted, or becomes open to public inspection before acceptance. The date which the patent will bear, if granted, will appear in a subsequent list of complete specifications accepted.

Nos. 1—386.

CARPENTER, H. A.—"Operating generators." No. 336. "Charging and discharging gas-retorts." No. 337.
CHANDLER, D.—"Gas-furnaces." No. 10. "Crucibles to be used with gas-furnaces." No. 176.
DAVIS, H. N.—"Gas-burners." No. 75. "Gas-fires." No. 76.
DAWSON, R.—"Coin-freed gas-meter." No. 217.
DRAKE, W. A. AND DRAKES, LIMITED.—"Regenerative furnaces." No. 7.
FLETCHER, W.—"Gas cooking-rings." No. 91.
HABICHT, P.—"Gas-heated flat-irons." No. 123.
HALL, I.—"Burners." No. 47.
HAM, M. B.—"Combined holder for packing and adjusting inverted mantles." No. 350. "Adjustable incandescent ring for inverted mantles." No. 351.
HIBBARD, R. L.—See Carpenter. Nos. 336 and 337.
IONIDES, A. C.—"Combustion of gaseous mixtures." No. 129.
Riter-Conley Manufacturing Company.—"Operating gas-generators." No. 335.
RITER-CONLEY MANUFACTURING COMPANY.—See Carpenter. Nos. 336 and 337.
RUTHVEN, R. H.—"Extraction of toluol, benzol, and other hydrocarbons, from gas." No. 74.
SHAKESPEAR, G. A.—"Detection and measurement of gases." No. 112.
SNELL, C. SCOTT.—"Gas-fires." No. 106.
SOUTH METROPOLITAN GAS COMPANY.—See Chandler. Nos. 10 and 176.
THEISEN, H. E.—"Atomizing apparatus for purifying, cooling, and mixing gases." No. 225.
THOMSON, W.—See Ruthven. No. 74.
TOWL, A. PEARCE.—See Fletcher. No. 91.
TWIGG, W. R.—See Davis. Nos. 75 and 76.
WALKER, W. C.—See Fletcher. No. 91.
WARNER, A. W.—See Carpenter. Nos. 336 and 337.
WHITE, A. E.—See Riter-Conley Manufacturing Company.—No. 335.

Leakage at Sutton-in-Ashfield.—At the last meeting of the Sutton-in-Ashfield Urban District Council, Dr. F. D. Martyn directed attention to the fact that the Auditor's report attributed the reduced profit on the gas undertaking to leakage from the mains; it being said that steps were being taken to effect a remedy. The leakage was put down at 13 per cent., which was a serious item. It had been urged that they should all economize at this time in respect of personal expenditure; and he thought some economy should be exercised regarding such a formidable leakage as was here revealed. Mr. Briggs (the Chairman of the Gas Committee) explained that the leakage had increased by 2 per cent. since last year, which he suggested was not a big loss compared with other places. Since he had been on the Council, the leakage had been as much as 30 per cent.; but it had been gradually worked down to 11 per cent. The leakage was due to the fact that there were so many colliery workings in the district; and occasionally some little time elapsed before the leakage was discovered.

LEGAL INTELLIGENCE.

A CLAIM FOR GAS POISONING.

Jury Stop the Case.

At the Berkshire Winter Assizes, Reading, on Thursday and Friday of last week, Mr. Justice AVORY and a Special Jury were occupied in hearing the case of *Lockyear v. Kingsclere Board of Guardians*, in which the plaintiff claimed damages for the breach by the defendants of a legal duty and (or) of an implied contract not to expose her to unreasonable risk and danger while she was in the employment of the defendants; and, alternatively, damages for personal injuries caused by the negligence of the defendants or their servants in exposing her to an escape of gas by which she was poisoned.

Mr. POWELL, K.C., and Mr. RATTO were Counsel for the plaintiff; Mr. VACHELL, K.C., and Mr. MICKLESWAITHE appeared for the defendants; while Mr. R. C. OWEN-WELLS held a watching brief for a party interested.

The statement of claim set out that plaintiff was employed by defendants as assistant nurse at the Kingsclere Poor Law Institution. In the course of such employment, plaintiff performed night duty on alternate months, and was obliged to occupy a certain duty room, which was lit by coal gas. On or about Nov. 8, 1913, while occupying this room, she noticed a smell of coal gas, caused by a leakage in the gas-fittings or connecting-pipes. In about a week the odour became more apparent; and plaintiff thereupon saw the Master, and requested him to cause the defect to be remedied. Several days after, as no steps had been taken, plaintiff reported the matter to a porter at the institution. About midnight on Nov. 25, 1913, while on night duty, plaintiff was suddenly taken ill with violent pain and sickness, which continued the following day and night, and prevented her attending to her duties. Dr. Maples, Medical Officer of the institution, examined her, and pronounced her suffering from poisoning caused by the inhaling of putrid coal gas. Her condition became rapidly worse, and she suffered great agony, and occasionally completely lost consciousness, and for a considerable time was in danger of losing her life. Except for a period of about a fortnight, the defendants provided medical attendance and nursing for plaintiff at the institution, until Nov. 7, 1914, when she was removed to the house of her sister at Newbury, and was till about March 7, 1915, attended by Dr. Adams, on whose advice she was removed to the Royal Berkshire Hospital, Reading. Since May 25, 1915, she had been treated at her home, and attended by Dr. Heywood. As a result of her illness plaintiff completely lost the use of her legs, so that she could neither walk nor stand, and she was still unable to walk without assistance. The defendants, after notice, discharged plaintiff from their service at the end of March, 1915, since which time, owing to physical weakness and nervous breakdown, due to her long and severe illness, the plaintiff had been unable to follow any employment. Special damages were set out, amounting to a total of £61 10s., and the plaintiff claimed £500 as damages. In their statement, the defendants denied that there was any leakage in the gas-fittings or connection-pipes, or any escape of gas, and also that the illness of plaintiff was caused by gas, or arose from any neglect or default on the part of the defendants or their servants.

Mr. POWELL, in his opening statement, admitted that the case was of a somewhat unusual character. The Guardians or their officials had not taken due care in seeing that gas of the best quality should be supplied, and that the fittings should be efficient; while on complaint being made that something was wrong, prompt steps should have been taken to remedy the defect. He did not know whether the Guardians would have any remedy against the Gas Company; but the plaintiff's case was against the Guardians.

Plaintiff bore out the opening statement, and medical evidence was then called, after which

Mr. *W. R. Davey*, the Manager of the Gas-Works at Newbury, said he was acquainted with the Kingsclere Gas-Works, which he supposed were established about fifty years ago. Some portions of the plant were excellent, and others were quite obsolete. The purifiers were just about equal to, or a little below, their capacity. If an extra quantity of gas was made at any time, the result must be that a considerable amount must go forward without the sulphuretted hydrogen having been removed. He did not understand the phrase "putrid gas." The characteristic smell of sulphuretted hydrogen was that of rotten eggs.

E. W. White, a gas-fitter employed at the Newbury Gas-Works, said on March 9, 1915, he inspected some gas-fittings in the duty room at the Kingsclere Poor Law Institution. The joints of the pendant were very loose; and about 2 feet of the main (compo.) pipe on the ceiling, from which the light depended, had a corked hole, not sealed over, from which a connection had apparently been taken off. He found no leak.

This closed the case for the plaintiff.

Mr. VACHELL raised the point that the statement of claim in the pleadings had not been borne out that the illness was caused by a leakage of gas from the fittings, plaintiff herself saying that nothing was perceptible until she lit the gas.

His LORDSHIP said it was quite clear a different case was now put forward. There had been no evidence of an escape of gas.

Mr. VACHELL, in addressing the Jury, said that plaintiff must have damages if they were satisfied that she had suffered in consequence of some defect in the gas supply, and that, if there was such defective supply, it was due to the negligence of the defendants. There was no guarantee by the Guardians that the atmosphere of the house should be pure—they could only take ordinary and reasonable care.

Mr. *Walter H. Bell*, an architect and surveyor, put in a plan of the duty room. One of the windows would open; and there were two fixed lights.

Mr. *J. R. P. Thomas*, the Master of the institution, in his evidence, said the smell of gas became objectionable throughout the house on Nov. 21; but there was no smell when it was burning. The smell lasted three days. The gas was not cut off at the meter, because there

was a lamp on the service which lighted a dangerous corner. Plaintiff never complained of any escape of gas, nor of the gas smelling. He never noticed any smell except during the time mentioned.

In cross-examination, witness said the complaint of the gas was general throughout the village. He warned plaintiff not to burn gas in the lying-in or sick wards, but said nothing in particular about the duty room.

Dr. *Reginald Maples*, Medical Officer of Health for the Kingsclere Rural District area, said he had attended plaintiff for a few months of her appointment. She frequently ailed from gastric trouble, which he attributed to chronic ulceration of the stomach. About Nov. 15 there was no sign of escape of gas, and the odour was not remarkable. As to his entry on Nov. 21 respecting "putrid gas," he stuck to these words. He condemned the gas, and the whole of the district was the same. He had several patients affected in the same way. He certainly did not attribute her condition to escaped coal gas—she was certainly suffering from ptomaine, and was dangerously ill at the time. She continued under his care until Feb. 7. In the cupboard used by her he found patty-pans which were mouldy and covered with verdigris, and a very dirty baking tin. He thought that they were undoubtedly a possible source of the ptomaine poisoning. It was absolute imagination that he said to any of the assistants that plaintiff was suffering from gas poisoning, or that he said to plaintiff that he had condemned the gas, or that ptomaine poisoning was caused by the gas and not by the food she had.

In cross-examination, witness said from the first he had undoubtedly been of opinion that it was food poisoning. He told Mr. Thomas, the Master, that plaintiff's statement that he had said she was suffering from the effects of putrid gas was not correct. He believed that eating from the dirty tart or patty pans was the cause of the illness, and it had nothing to do with gas.

Professor *H. Wilson Hake*, Ph.D., gave evidence that in his opinion plaintiff's symptoms could not possibly have been caused by an escape of gas—still less by inhaling the products of burnt gas.

Other evidence having been called, the Jury stopped the case and found for the defendants, for whom judgment was accordingly entered.

[Mr. Norton H. Humphrys, of Salisbury, was retained as technical adviser and witness for the defence; but the case was stopped before his evidence had been called for.]

WATER-GAS PLANT PATENTS IN AMERICA.

United Gas Improvement Company v. Gas Machinery Company.

The Gas Machinery Company, of Cleveland, Ohio, write stating that the suit against them brought by the United Gas Improvement Company charging infringment of the Rusby patent No. 857,760, which it was claimed covered an air-metering device for water-gas apparatus, has been decided in their favour. They submit the following statement relating to the suit:

About three years ago the United Gas Improvement Company sued the Gas Machinery Company, charging infringement of the Rusby patent No. 857,760, held by them to cover the attachment of an air-metering device to water-gas apparatus, and the Dickey patent (No. 940,925) said to cover the attachment of a steam-metering device for water-gas apparatus.

The case was tried before Judge Day in the United States District Court at Cleveland, Ohio, the latter part of 1913. In deciding the case, the Court held that the Dickey patent was invalid, but that the Rusby patent was valid, and had been infringed by nine water-gas sets that the Gas Machinery Company had installed and had provided with Pitot tube air-meters.

The Gas Machinery Company appealed from Judge Day's decision, in so far as it related to the Rusby patent. The United Gas Improvement Company, however, did not appeal from the part of the decision which held that the Dickey patent was invalid.

The Court of Appeal for the Sixth Circuit has just handed down its decision on the appeal taken by the Gas Machinery Company, and has reversed the judgment of the Lower Court, and held that the Rusby patent is also invalid.

The reason stated by the Court for their decision is that the specification discloses an unpatentable aggregation of old elements, and not a patentable combination of co-acting elements. Concerning this particular point, the Court say in their opinion: "We conclude that the relation of Rusby's ajutage and gauge to the 'set' is the relation between the items of an aggregate, and not the relation between the elements of a combination. This conclusion depends on the general proposition that a metering device—the only office of which is to measure the raw material entering a machine, so that the operator may stop when he has put in enough—does not so co-act with the machine itself as to be properly characterized as being in combination therewith. The operation of the ajutage is as obscure as its name is unfamiliar; but in spite of this, it does nothing except indicate, and, in a sense measure, the entering air. It does not co-operate with the three main members of the set any more than does the oil-measuring device or the steam-measuring device, or, for that matter, the scales that weigh the coal. Indeed, it is just as important to the operator to know the period of elapsed time as it is to know the rate of flow of the air; and the clock that tells him when to close the valve fully is as essential to the gas-making operation as is the gauge which tells him when to shut it part-way. It is only another form of expressing the lack of real combination to say that the gas-making apparatus does not extend beyond the gates at which the materials enter; and it is only fortuitous that the air-measuring device happens to be set close to the entrance valve. It might as well be in another room. Upon principle, it seems clear to us that a mere measuring device, which does nothing, and can do nothing, except give the operator information as to how much material is going into the machine, is no part of a true combination of the operative elements of the machine; and we can find no case where the contrary has been held."

MISCELLANEOUS NEWS.

SULPHATE OF AMMONIA AND NITRATE OF SODA.

Messrs. Bradbury and Hirsch's Market Review for 1915.

The great disabilities under which they have been labouring in its preparation, owing to the international situation, are emphasized by Messrs. Bradbury and Hirsch, of Liverpool, in the opening lines of their "Review of the Sulphate of Ammonia and Nitrate of Soda Markets for 1915"—a copy of which has come to hand. They say that the circumstances existing at the beginning of the year, and the new factors which have come into play during the year, have been so far abnormal that previous business experience has been practically useless for guidance. The year's experience, however, ought to make it possible to take more reliable views of the outlook than was the case twelve months ago, as there has been time for adjustment to the altered circumstances. But there will necessarily have to be a re-adjustment when the war comes to an end; and that time may conceivably occasion as many trying situations as the course of the war has disclosed. Again the hope is expressed that, before the time arrives for writing the next review, peace may have been established on a solid and satisfactory basis.

NITRATE OF SODA.

Nitrate of soda is first dealt with in the review; and as to this, Messrs. Bradbury and Hirsch remark that the conditions which have prevailed during the past twelve months have been so far exceptional that they cannot be compared in any way with those which have governed the market during any other period in the trade's history. It would be useless, therefore, to attempt to establish any comparison between 1915 and the previous year, or any other year, or to reason on the lines hitherto followed. Moreover, inasmuch as complete figures representing deliveries, &c., in Europe are not obtainable, they think it would serve no useful purpose to give the figures which are procurable. The outstanding facts in the situation at the end of 1914 were the stoppage of direct shipments to Germany and Belgium, unprecedentedly heavy stocks on the west coast, and, on the other hand, a rapidly decreasing output. There might, perhaps, be added the fact that in the United States there was a shortage of supplies, which were bound to be replenished early in 1915, though this fact was only of minor importance in relation to the other three. Demand for munition purposes had hardly made itself seriously felt. When it is pointed out that the imports into Germany and Belgium in 1913 amounted to about 1,150,000 tons—or nearly twice as much as those into the rest of Europe, including Egypt, during the same period—it will be appreciated how serious a matter it was that such an outlet should be blocked. Of course, it was known that supplies would find their way indirectly into Germany and Austria; but manifestly such supplies could not constitute a serious offset against the shrinkage in direct shipments referred to. The west coast stocks at the end of 1914 were estimated at about 1,120,000 tons—an increase of 625,000 tons during the year, and due largely, though not altogether, to the outbreak of the war and consequent shrinkage in shipments. The increase in stocks up to the end of July had, in fact, been such that the curtailment of output was under consideration when the war broke out; and some thirty to forty officinas had already been closed-down. From that time up to the end of 1914, the process of closing-down had been steadily proceeding.

The Course of Prices.

The most prominent factors during the year, the report proceeds, were the continued closing-down of officinas in the early months, and the re-opening of them when the market improved, the phenomenal advance in freight rates, and the almost world-wide demand for nitrate of soda for munition purposes. By the end of March, only about one-fifth of the total number of officinas were still working; but from April forward there was a well-sustained demand up to September, when the stoppage of the Panama Canal gave a further impetus to buying, and within a month a very large business resulted at up to 9s. 7d. per quintal. When fresh chartering had to be done, however, it was found impossible to secure the necessary tonnage, even at the further inflated freight rates which the fresh demand brought about. With advancing free alongside prices, officinas had re-opened; and at the close of the year the output was fully equal to that before the war. Manifestly, the firm say, it has outstripped the world's requirements, including the very large requirements for munition purposes, with Germany out of the market; and they do not see that the inflated prices paid in October were justified, even if freight room had been obtainable. Before October was out, there was a relapse in prices; and at the close the value was not more than about 7s. per quintal. Whether even 7s. per quintal can be maintained, is more than doubtful, unless producers very soon come to an agreement to curtail production all round. Having regard to prices current in Europe and the United States, the year's working cannot be considered as very satisfactory from the point of view of producers. Importers have probably good reason to be satisfied; but undoubtedly the lion's share has gone into the pockets of shipowners.

From 10s. per cwt. at Liverpool at the outset, there was an advance to 10s. 4½d. in January, to 11s. in February, to 12s. 6d. in March, and to 12s. 6d. in April. After advancing to 13s., there was a decline to 12s. 6d. in May, and to 12s. 1½d. in June. There was a recovery to 12s. 3d. in July; and in August 13s. 9d. became the price. There was a decline to 13s. 4½d. in September; but in October there was an advance to 14s. 4½d. Through November the price remained at 14s. 4½d.; but in December it was put up to 15s. 3d. The average price for the year worked out to 12s. 4½d. per cwt. When the year opened there was hardly a west coast market at all; and the nominal value of ordinary quality was not more than about 5s. 6d. per quintal, free alongside. In February, there was an improvement in tone, and 6s. per quintal became the quotation. There was a gradual improvement in March; and in April 6s. 6d. was paid. There was an advance to 6s. 9d. in May, to 7s. in June, and to 7s. 7d. in July. In August 8s. 3d. was

reached; and in September as much as 9s. 3d. was paid. Up to 9s. 7d. was paid in October; but from that time there was a steady decline, and at the close the value was not over 7s. The average price for the twelve months was 7s. 7d. per quintal.

The nominal freight rates at the end of 1914 were about 30s. and 60s. per ton, for sail and steam respectively. For sail, all through June, July, and August, 1915, the rate was fairly steady at about 65s. per ton; while the rate for steam was 80s. per ton in August, and 82s. 6d. in September. The blocking of the Panama Canal led to extra demand for tonnage in October, especially for steam; and a big advance in rates was demanded. At the close, there would probably be charterers at 85s. per ton for sail and at 125s. per ton for steam, for early 1916 loading. It will, it is added, thus be seen that the question of tonnage has been the governing factor in the nitrate of soda trade in 1915; and that if tonnage had been sufficiently plentiful, there would have been an abundant supply of nitrate of soda for all purposes.

As to prospects, although the firm feel that they cannot attempt to prognosticate in the absence of sufficient data to work on, there are several facts which seem to have a bearing upon the present situation. The exports from the west coast to Europe (including Russia) in 1915 were something over a million tons, against less than 2 million tons in 1913, when Germany and Belgium together took nearly two-thirds of the whole. The margin provided for munition purposes by the shipment of upwards of a million tons in 1915 would seem to be more than sufficient had the Panama Canal not been blocked; and, but for this accident, they hardly think there would have been such an advance in prices as occurred within the past three months. Then, shipments to the United States in 1915 were about 800,000 tons—nearly 300,000 tons more than in 1914. From this, one would argue that at the present time the United States is probably well supplied, notwithstanding increased use for chemical purposes; and that it will be less keen to compete for available tonnage on the west coast than will buyers for the European market. If the Panama Canal is re-opened at the end of January, as anticipated, there may be a chance of easier prices as larger supplies become available; but otherwise the firm think that even a higher level of prices may be reached before the spring months are over. The stocks on the west coast are estimated to be about 800,000 tons. They are still increasing, and there will be no indisposition on the part of producers to sell. But so far as the European market over the spring months is concerned, nothing will depend upon this.

SULPHATE OF AMMONIA.

Turning now to the question of sulphate of ammonia, Messrs. Bradbury and Hirsch say that in their concluding remarks upon the situation at the end of 1914 they expressed the opinion that one might dismiss Continental production from consideration, inasmuch as it could only find its way to the world market through Holland and Italy, even if supplies were available, and that it was not likely that exports on any extensive scale could be sent through these countries under the conditions then existing. This view necessarily led to the further conclusion that the prospects of the market must be considered from the point of view of output in the United Kingdom and the United States; the output outside these two countries, and available, not being enough to have any appreciable effect upon the market. Seeing, too, that more than the whole output in the United States is always required for home consumption, they thought the problem might be further narrowed, and considered solely from the point of view of the United Kingdom supply.

From the above starting-point, they had to consider the prospect of an adequate demand; and, in the first place, it seemed likely that the stoppage of shipments to Germany and Belgium might be balanced by the larger demand from France, Italy, and Spain, since all these countries had drawn some supplies from Germany in 1914. Then, the exports from Germany and Belgium to Holland and the Dutch East Indies, in January-April, 1914, were nearly 30,000 tons; and if the opinion that Germany would not have any sulphate of ammonia to spare in 1915 was correct, it followed that Holland and the Dutch East Indies would have to depend upon the United Kingdom for their supplies. It was within the firm's knowledge that buyers in the United States had had to cancel contracts for German output; but it had also transpired that they were cancelling contracts with the United Kingdom. So it did not necessarily follow that British output would have to be substituted for the German shortage in the early months of 1915. The cotton-growing industry in America was, in fact, in such a demoralized condition that it was not clear what the upshot of the campaign in that country might be; but the prospects were by no means bright. There had been a heavy falling-off in shipments to Japan during the preceding six months; and it was not possible for the market to count with confidence upon that country for support over the coming season. There was, however, in the price of sugar and in prices of all cereals every inducement to fertilize on the most liberal scale outside the war area; and inasmuch as nitrate of soda does not seriously compete with sulphate of ammonia outside the Continent, unless in the United States, they anticipated a still higher level of prices for sulphate of ammonia over the spring months of 1915—German output not being available.

Export Business.

Though, of course, new factors came into play to disturb calculations, Messrs. Bradbury and Hirsch point to the tables of exports, to show how far their anticipations were justified. These indicate the total exports for the past two years to have been as follows:

	Year 1915. Tons.		Year 1914. Tons.
France, Germany, and Belgium	11,430	..	6,945
Spain and Portugal, Italy, and the Canaries	77,113	..	72,855
Holland, Java, British Guiana, the West Indies, and Mauritius	161,974	..	86,510
Japan	10,537	..	87,776
United States	16,377	..	43,651
Other countries	16,877	..	16,140
Total exports	294,308	..	313,877

Commenting on the tables [for the details in which readers must be referred to the review itself], the firm point out that the January-March table shows there was not the increase in shipments to France which was expected. An increase of 19,549 tons to Holland inside three months, on the top of heavy shipments towards the close of 1914, was too significant to be overlooked; and the Government took action to control further shipments in this direction. The extraordinary shrinkage in the shipments to Japan was accounted for by the fact that freight room to Europe had become so scarce, and freights so inflated, that it was impossible to export more than a portion of the bean crop to advantage. The falling-off in requirements for the United States was in January, while the cotton-growing outlook was still in suspense; and the absence of any recovery later was no doubt due to larger home output. The January-April table shows that the measures taken by the Government to control exports had been effective, and that shipments to Holland had been brought to a full stop. There was a further shrinkage in the shipments to Japan and the United States; but there was a very satisfactory recovery in French requirements. The January-June table shows that, whereas at the end of April shipments to Spain were in arrears to the extent of 7361 tons, they were at the end of June 1280 tons ahead of the shipments for January-June, 1914. The largest 1915 shipments held up in April owing to insufficient freight room had been shipped in May and June. The shipments to Holland in May and June were under effective control, and were only slightly in excess of those in May and June, 1914. Those to the United States were about on a level with those in May and June, 1914; but within the same period there was a shrinkage of no less than 11,633 tons in the shipments to Japan. On a survey of the whole six months, the outstanding features are the shrinkage of 39,969 tons in the shipments to Japan and of 7615 tons in those to the United States, against increases of 21,557 tons in the shipments to Holland, of 15,050 tons to the sugar-growing Colonies (including Cuba), and of 5790 tons to other countries, of which 5490 tons went to Sweden and Denmark. Had Japan been buying on anything like her previous scale, there must have been a sulphate of ammonia famine and corresponding prices; while with Japan almost "out of the hunt," but for the intervention of Holland and Sweden there must have been a glut of supplies and a slump in prices. It has been attempted to show that the excess quantity taken by Holland and Sweden up to the end of March—25,039 tons—and which occasioned the action of the Government, was required to replace what had been taken from Germany in other years. But the figures are altogether against the contention; the Dutch import from Germany in January-April, 1914, having been only 11,946 tons, and in 1913 only 9238 tons, while Sweden took none. Under the conditions prevailing, the reviewers do not think that a shrinkage of only 4468 tons in the total shipments from the United Kingdom over the six months can be regarded as other than satisfactory.

The striking features about the July-December figures are the remarkable increase in shipments to the sugar-growing Colonies and the further shrinkage in shipments to Japan The total shipments to Java from the United Kingdom in 1915 were 93 496 tons—figures never even approached when that country was exclusively supplied by the United Kingdom. The shrinkage of a further 37,270 tons in the shipments to Japan was not unexpected; but the shrinkage of 19,659 tons in those to the United States is not so easily explained. Of course, the United States imported much larger supplies of nitrate of soda, and these may to some extent have ousted sulphate of ammonia; but the firm think the increase has been very largely used for other than agricultural purposes.

If the exports for the whole year are compared with the exports in 1913, it will be seen that the entire trade has been turned upside down by the war, either directly or indirectly. The exports to the Continent have shrunk from 23,521 tons in 1913 to 11,430 tons in 1915, those to Japan from 114,684 tons in 1913 to 10,537 tons in 1915, and those to the United States from 37,067 tons in 1913 to 16,377 tons in 1915; while the shipments to Holland and the sugar-growing Colonies have increased from 60,275 tons in 1913 to 161,974 tons in 1915, and home consumption (for all purposes) from 105,000 tons in 1913 to 128,000 tons in 1915. Exports to Spain have also increased substantially; and they would have made a still better showing if permits to ship had been granted more freely.

The Course of Prices.

On the subject of prices, Messrs. Bradbury and Hirsch remark that no recent year has opened under more favourable conditions, from the British sulphate of ammonia manufacturers' point of view, than 1915. With Germany out of the competition, and with the prospect of exceptional demand for the sugar-growing Colonies, the way to ample demand and to higher prices seemed to be quite clear from the outset. Probably the advance from £12 2s. 6d. to £13 13s. 9d. per ton in January was more than was expected, having regard to the mild fluctuations which the market had been accustomed to over so many years. The set-back to £13 12s. 6d. per ton in February, to £13 10s. in March, and to £13 8s. 9d. in April, was due in the first instance to the defection of Japan and the United States; but it was contributed to in April by Government intervention in regard to shipments to Holland, and by the inadequacy of railway and shipping facilities—the shrinkage in the total shipments up to the end of April, compared with the shipments in January-April, 1914, being no less than 10,032 tons. Belated shipments, more particularly those to Spain, were, however, made good in May and June; and there was a recovery to £13 17s. 6d. per ton in May, and to £14 8s. 9d. in June, by which time Government requirements for munitions had begun to make an impression.

By the end of the first week in July, the upward movement had spent itself, belated shipments having been disposed of, and there being no other special demand; and the market was quiet up to the close, when the price was £14 13s. 9d. per ton. Owing mainly to the difficulty in obtaining shipping permits from the War Trade Department, and to the hesitancy of buyers abroad about placing further orders, the price gradually declined to £14 10s. per ton in August. There was very little fluctuation in September; and at the close £14 10s. per ton was still the price. In October, however, there being a well-sustained demand, there was a steady and rapid advance from the outset up to the close, when £15 7s. 6d. per ton had been realized. By this time,

Government requirements for munition purposes had become a real factor in the situation; and the reservation, at the instance of the Board of Agriculture, of a proportion of the output of sulphate of ammonia for home agricultural purposes had also to be taken account of by buyers. Moreover, the Government strings controlling shipments to Holland had been slackened. The consequence was a strong demand from practically all foreign markets, excepting the Japanese, and an advance in prices up to £16 7s. 6d. per ton—the highest point reached since 1883.

The average price for January-June was £13 10s. 7d. per ton, or £1 13s. 3d. above the average price for January-June, 1914. The average price for July-December works out to £15 4s. 7d. per ton, or £4 7s. 9d. above the average price for July-December, 1914. The average price for the year is therefore £14 7s. 7d. per ton, or £3 0s. 6d. above the average for 1914; and it is necessary to go back as far as 1884 to find a higher average price in any year—viz., £14 9s. 3d. per ton. Such a result can only be attributed to the accident of war, whereby Germany, who had become a very serious competitor with the United Kingdom in the world market, has been "out of the running." The high average price has, moreover, it is pointed out, to be very substantially discounted to cover the inflated cost of acid, coal, labour, &c. But, when full allowance is made to cover the increased cost of manufacturing, the net result must be considered to be highly satisfactory, though not as satisfactory as the result in 1912, when the cost of manufacturing was about normal, but the output was largely affected by strikes.

Figures Regarding Output.

The output in the United Kingdom in 1914 proved to be 426,000 tons, or a decrease of 6000 tons on 1913; there having been a decrease of 6000 tons from gas-works and of 4000 tons from iron-works, against an increase of 4000 tons from carbonizing, &c., works. The reviewers find it impossible to estimate with much confidence the output during the past year; there being scarcely a single industrial concern or a gas-works which has not been affected for better or worse by the war conditions which have existed. From figures and opinions furnished to them, however, they think it well to give the conclusions at which they have arrived. The production of ammonia, calculated into sulphate (including that used in the manufacture of ammonia soda, munitions, and for other chemical purposes), from all sources in the United Kingdom during 1915, they estimate, with all reserve, at 423,000 tons, divided up as follows:

	Tons.
Gas-works	173,000
Iron ,,	16,000
Shale ,,	58,000
Coke and carbonizing works and producer gas	176,000
	423,000

Of this total, it is estimated that England contributed 302,000 tons, Scotland 118,000 tons, and Ireland 3000 tons. The production in tons of the previous four years was:

	1914.	1913.	1912.	1911.
Gas-works	176,000	182,000	172,000	169,000
Iron ,,	16,000	20,000	17,000	20,000
Shale ,,	63,000	63,000	62,000	61,000
Coke and carbonizing and producer gas	171,000	167,000	137,000	135,000
Totals	426,000	432,000	388,000	385,000

Messrs. Bradbury and Hirsch's estimate of production in the United Kingdom in 1914 was 5000 tons under the mark; the shrinkage in the output from carbonizing, &c., works during the first half of the year having been more than balanced by the larger output in the second half. They are satisfied that their estimate of stocks at the end of the year was substantially correct, and that the increased output disappeared in home consumption—partly, if not mainly, in the production of munitions. On this assumption, the account for the year 1915 will stand as follows:

	Tons.
Stocks brought forward from 1914	25,000
Production in 1915	423,000
	448,000
Exports during 1915	294,000
Home consumption (for all purposes) in 1915	128,000
Stocks to carry forward into 1916	26,000
	448,000

Market Prospects.

Production.

The production of ammonia calculated into sulphate in the United States during 1915 is estimated by the American Coal Products Company to have been 212,000 tons—an increase of 17,000 tons upon the actual output in 1914. It is, further, estimated that something like 79 per cent. of the 1915 output has been from bye-product coke-ovens; and in view of the keen demand for coke and for the bye-products, it seems certain, say Messrs. Bradbury and Hirsch, that a further substantial increase in the output of sulphate of ammonia in the United States must be counted upon in 1916. For the same and for other reasons, they think that there will be an increased output in the United Kingdom in 1916; but it is quite impossible to estimate what it may amount to. There will no doubt be some increase in production in Japan and other countries; but as this will not come on to the world market excepting to slightly limit demand upon the United Kingdom, they think they may proceed to the consideration of the outlook from the point of view of the United Kingdom supply alone, as they did at the end of 1914—more than the entire output in the United States being required for home consumption.

What, then, it is asked, are the chances of the market over the coming season? Replying to this question, the reviewers say it may help to clearness of vision if it is remembered that the shrinkage in shipments was about 36,000 tons to Japan and the United States, in January-April last, compared with January-April, 1914, and that this shrinkage was practically balanced by the increase in shipments to Holland, Java, and Sweden over the same period. Seeing they are of opinion that the course of the market may eventually depend upon shipments to the above-named countries over the next four months, more than upon anything else—excepting perhaps home demand for munitions—they think it well to discuss the chances of larger or smaller shipments in some detail. Though there was a shrinkage of about 36,000 tons in the shipments to Japan and the United States in January-April last, these two countries took between them nearly 16,000 tons during that period. So far as can be judged, they are not likely to take more than half as much over the next four months. Against the increase of 36,000 tons in the shipments to Holland, Java, and Sweden in January-April last, it may safely be assumed that Sweden will get none—against rather less than 5000 tons last season. The quantity permitted to be supplied to Holland will be determined by the War Trade Department; and, inasmuch as the brake was applied rather sharply when 21,155 tons had been reached at the end of March last, they are of opinion that it may also be assumed that the intention is to reduce the limit for the next three or four months. In dealing with the case of Java, a longer period than the four months from January to April should be taken for comparison, because Java is further away from the market, and has quite obviously been anticipating requirements. Shipments from July, 1914, to April, 1915, when Germany was not in competition, amounted to 48,035 tons, against 23,799 tons for July, 1913, to April, 1914, when Germany was competing—an increase of 24,236 tons. Against 48,035 tons which Java took from July, 1914, to April, 1915, she from July up to the end of December took no less than 58,814 tons—that is to say, 10,779 tons more than she took altogether from July, 1914, to April, 1915. In view of this, is Java over January-April, 1916, likely to require very much of the 20,491 ton. which she took during January-April, 1915? The firm think not, after making every allowance for the stimulant of the famine price of sugars Spain will take larger quantities no doubt, as will also the West Indies and other sugar-growing countries, but not more than enough to compensate for the shrinkage anticipated in the Japanese and United States demand.

Prices.

From the point of view, therefore, of probable external demand over the coming season, Messrs. Bradbury and Hirsch do not see that any higher level of prices is justified. One must, they say, consider the home situation to understand the rapid upward movement in prices which has been going on since the beginning of October. The demand for ammonia for munition purposes, which has been steadily increasing during the past nine months, is a new factor in the case. It is, of course, impossible to get any exact estimate of what this demand now amounts to per month; but in coming months it is certain that it will be out of all proportion to any increased output there may be. Then, as already pointed out, pressure has been brought to bear upon producers to reserve a proportion of their output for direct sale to farmers, at preferential prices, in order to induce a larger home consumption. Whether the scheme will achieve the object intended, the firm are inclined to doubt, because, as hitherto, this same trade has been provided for by manure manufacturers and local distributors by purchases and preparation made in advance. The farmers are therefore being catered for from two sides, which are bound to come into conflict; and it does not seem likely that manure manufacturers and local distributors will let the business slip through their fingers—especially if this involves the carrying of their stocks forward to another season. However that may be, there can be no question that the reservation itself on the top of actual requirements for munition purposes made a decided impression upon the minds of buyers, both at home and abroad, the effect of which has been seen in the shape of exceptionally heavy purchases the past three months for delivery ahead; it being realized that requirements for both purposes would be a first call on the supply.

There has, they proceed to point out, been another reason for this heavy purchasing. Last season's experience has not been lost upon buyers abroad. If freight room was insufficient over the vital months last spring, it is likely to be still more limited in 1916. If freight rates had advanced last spring, they are on a still higher level now; and they have probably not yet reached the ultimate. It is not surprising, therefore, that buyers abroad should wish to avoid the losses and the inconveniences to which they were subjected last season, and be anxious to anticipate their prospective requirements by a month or more. This is exactly what they have been doing; and this action has no doubt contributed materially to the recent advance in prices. So far as this policy has succeeded, it will follow that requirements will be smaller later on; but this cannot in the meantime affect the situation which has been created. The question of the supply of sulphuric acid will become more acute as the demand for munition purposes increases, and there must in consequence be some shrinkage in the output of sulphate of ammonia. But, inasmuch as the Munitions Department can make use of concentrated liquor in place of sulphate of ammonia, the shrinkage in the actual output of sulphate does not require to be allowed for in this calculation. It has been taken account of in requirements of ammonia for munition purposes.

The reviewers do not see, in the actual circumstances, reason to doubt the stability of the market for some way ahead at least. But if, as they suggest, buyers have, on the advancing market, bought more heavily and for earlier delivery than usual, they are of opinion that there may possibly be a set-back in prices when the summer months are reached. The extent of the demand for munition purposes will probably settle the latter point.

The concluding portion of the review is, as usual, devoted to an account of the market during the different months of the year; and there is also given the following list of

Average Prices of Sulphate since 1867.

Figures quoted at the end of the review show the following to be the average prices per ton since 1867 of good grey 24 per cent. sulphate of ammonia f.o.b. Hull: 1867, £11 10s. 1868, £14 10s. 1869, £15 15s. 1870, £16. 1871, £19. 1872, £21. 1873, £18 3s. 9d. 1874, £17 2s. 6d.

1875, £18 10s. 1876, £18 12s. 6d. 1877, £19 16s. 3d. 1878, £20 5s. 1879, £18 8s. 9d. 1880, £19. 1881, £20 4s. 6d. 1882, £20 8s. 6d. 1883, £16 11s. 1884, £14 9s. 3d. 1885. £11 9s. 1d. 1886, £11 3s. 7d. 1887, £11 17s. 8d. 1888, £11 18s. 1889, £12 1s. 4d. 1890, £11 9s. 1891, £10 15s. 5d. 1892, £10 1s. 10d. 1893, £12 11s. 4d. 1894, £13 3s. 8d. 1895, £9 15s. 4d. 1896, £7 18s. 0½d. 1897, £7 18s. 5d. 1898, £9 9s. 7d. 1899, £11 5s. 10d. 1900, £11 2s. 1901, £10 11s. 4d. 1902, £11 16s. 3d. 1903, £12 9s. 2d. 1904, £12 3s. 8d. 1905, £12 10s. 9d. 1906, £12 0s. 9d. 1907, £11 15s. 8d. 1908, £11 12s. 1909, £11 5s. 1910, £12 3s. 2d. 1911, £13 15s. 3d. 1912, £14 7s. 9d. 1913, £13 7s. 8d. 1914, £11 7s. 1d. 1915, £14 8s. 1d.

PUBLIC LIGHTING RESTRICTIONS.

The Question of Allowances to Local Authorities.

Finding that a number of members are still having disputes with their local authorities as to what allowance should be made in respect of diminished lighting in war-time, the British Commercial Gas Association reproduce in the January issue of their "Bulletin" extracts from a statement on the subject submitted by the Gas Light and Coke Company to a Government Department, and accepted by them as satisfactory. At the same time, it is pointed out that the arguments advanced obviously only apply where long-period contracts for inclusive service are in force, and no increase has been made in charges since the outbreak of war. The following are the extracts referred to.

The Company would have been justified, under their contracts for public lighting, in complying with the requirements of the Admiralty by completely obscuring the glass of the lanterns, and leaving the gas burning inside. [This has been done in some districts outside the Company's area of supply.] No question of allowance would then have arisen, as the Company would have been fulfilling their contracts, and also complying with the requirements of the Admiralty. It appeared, however, to the Company that this would be a gross waste of gas; and therefore, without prejudice to their contract rights, they agreed to extinguish those lamps which the Admiralty had directed should no longer give light.

The Company might then have taken the point that their contracts had been suspended by the outbreak of war and the subsequent reduction of the number of lamps in use, and have asked for a material revision in the prices charged for lamps in lighting, as the cost of gas manufacture has substantially increased (causing an increase in price of 6d. per 1000 cubic feet to the public); the salaries and wages of the staff and workmen employed upon public light work have had to be substantially increased to meet the higher cost of living; the cost of repairing and re-glazing the lamps has been doubled, owing to the scarcity, and consequent very high price, of glass and the increased cost of labour for this work; and the cost of all burner-parts and mantles has been steadily rising since the commencement of hostilities. Moreover, there is every reason to anticipate that, as a consequence of the war, the engagements recently made by the Company with the Commissioners of Works in regard to public lighting, for a period of ten years, will be far less favourable to the Company than was anticipated when the prices embodied in those engagements were quoted. The Company, however, have not asked that under these new conditions the prices they quoted for the ten years' agreement should be revised, either in respect of the period of the war or subsequently; and they therefore submit that they should not be called upon to make any allowance in respect of the lamps out of lighting (under circumstances outside their control) greater than the amount that they actually save as a consequence of not supplying gas to the lamps in question.

That saving only represents a very small proportion of the agreed charge per lamp when in lighting, because this charge includes, in addition to the cost of gas used, the repayment of the cost of new lamps, salaries, and wages of inspectors, foremen, and lamplighters, and the repair and maintenance of burners, lamps, and columns. In regard to all the charges other than gas, the Company effect no saving, as the increased costs of labour and material already specified more than counterbalance any small saving effected in labour employed and material used, owing to certain lamps not being in lighting. In regard to the saving effected through the non-supply of gas, this does not amount to more than 6d. per 1000 cubic feet, because our charges for gas supplied are largely comprised by capital, distribution, and administration charges that cannot be diminished when there is a sudden reduction in output. All that can be saved is the cost of the actual coal not used (less the residuals not produced), and a part of the wages paid for manufacture and purification.

From "Field's Analysis" for the year 1913, it will be seen that the net cost of coal in the case of this Company amounted to 4·45d. per 1000 cubic feet of gas sold; while the manufacturing and purifying wages amounted to 1·89d. and 0·33d. per 1000 cubic feet respectively. Not more than one-half of the last two items would be saved in the event of gas not being made; and we therefore get a total saving of 5·56d. per 1000 cubic feet. We have taken this at a round figure of 6d. This is the basis upon which we have made allowances to other lighting authorities with whom we have similar contracts to those into which we have recently entered with the Office of Works; and our allowances have, after similar explanations, been accepted as equitable by all those authorities—including the City of London, the City of Westminster, the Boroughs of Chelsea, Finsbury, Hackney, Holborn, Islington, and Stoke Newington, and the District Councils of Chingford, Hendon, Loughton, Wanstead, Willesden, and Woodford.

Salford War Bonuses Approved.—According to the printed minutes of the Salford Gas Committee, approved at the last meeting of the Town Council, the following bonuses have been granted to certain grades of employees: Labourers, 1s. per week; shiftmen, 2d. per shift; foremen (other than foremen of tradesmen), 2s. per week.

GAS AND ELECTRIC LIGHT COMPANIES UNDER ONE MANAGEMENT.

At the Ninth Annual Convention of the American Illuminating Engineering Society, held at Washington last September—the full report of which is contained in the issue of their "Transactions" received the early part of this month—a paper was read by Messrs. A. B. Spaulding and N. H. Potter, entitled "How can Gas and Electric Companies under One Management render the Best Light Service." It is prefaced by the following synopsis: This paper treats, from the commercial standpoint only, the subject of service to the customer by gas and electric companies under one management. It emphasizes the importance of service to the customer, and outlines the question of service from a practical standpoint. In discussing the selling force necessary for the proper handling of lighting business, the authors recommend the employment of specialists on gas illumination and specialists on electric illumination. The education of the salesmen is considered, and a successful local educational course is outlined. The education of the customer is discussed from the standpoints of the manufacturer of appliances and the lighting company. The relation between the representative and the customer is of special importance, and particular stress is laid on the matter of the maintenance of lighting units, which maintenance is in reality the "keynote of service."

One of the important subjects to-day among gas and electric companies is "How can the best service be given?" The engineering phases of this question have received marked attention, and the improvement in design and operation of gas and electric plants has increased the confidence of the public in the efficiency of these plants. This paper deals with the rendering of service after the product is delivered, or beyond the meter. There are differences of opinion as to how this can best be done.

Among the trio of products of gas and electric companies—light, heat, and power—light has always received the first place. Upon the selling of this product depended the initial success of all gas and electric companies; and the early history of both industries is bound up inseparably with the development of their lighting business.

There has been a radical change in the methods and personnel of the selling force. Heretofore gas and electric energy were the points of discussion with the consumer; but now illumination is the topic. Instead of so many cubic feet of gas, or watts of energy, illumination is being sold. On account of this advancement the illuminating engineer has developed; and the Illuminating Engineering Society is an outcome of the desire of gas and electric companies and manufacturers to render the public a service by united effort toward improved illumination.

The present estimate of the worth of any man must be, "How much does he produce?" and if any representative, no matter what his printed title may be, does not produce, he is not efficient.

Selling and service should be synonymous, and service has various phases. In order to render it intelligently it is essential, first, that the representative be capable of laying out and supervising a lighting installation; and, second, that the consumer be educated to appreciate the difference between proper and improper lighting, insofar as the value of proper lighting to his business is concerned.

Service does not necessarily mean the reduction of bills; it may, and often does, result in an increase in the amount of business with customers. Proper illumination is desired, and must be the primary factor in the discussion of cost, not only of electricity and gas supplied, but of fixtures and first installation. Service, therefore, means the providing of the illumination best suited to each customer at minimum cost. Both the representative of lighting companies and the public must be educated to the value, use, and maintenance of a lighting installation.

Gas and Electric Specialists on the Sale of Illumination.

The writers believe that with gas and electric companies under one management specialists on gas illumination and specialists on electric illumination are productive of the best results—particularly as regards service to the customer. This method is, in reality, intensive selling; and each man becomes an expert in either gas or electric illumination. Both men are selling the same thing—viz., illumination; and, unconsciously perhaps, each man picks out the most likely prospects.

It would seem that there is no good reason for a gas or electric company under one management adopting a policy which encourages only one source of supply. The duty of such a company is not to predetermine what source to sell, but to give the customer the benefit of the best advice, and leave to him the decision. That two sources are better than one is certain where gas and electric units are installed for general illumination. The units should harmonize with each other and with their surroundings. The only question which might influence the installation of a single source would be its adaptability.

The argument has been advanced that by having one man to sell both gas and electric illumination, the selling force could be cut in half. This is not true, if the business is to be taken care of properly. It has been contended that the consumer is confused by having two men advising different sources of supply. This may be true where companies are under separate management, and competition dictates a policy of "Get business anyway—but get it," rather than a policy of real service to the consumer. With a company under one management, the consumer is not confused by having information on both gas and electric illumination from different men. The customer should be credited with common sense and have the privilege of choice. By having both sides advanced to him by experts, he is able to consider economy, convenience, safety, &c., and in the end be sure that he is getting the method of illumination best suited to his needs.

Summing up, we find that separate gas and electric lighting representatives are in the end no more expensive than combination representatives. There is absolutely no question that this separation does stimulate the trade in a healthy manner. Each salesman becomes more proficient in the art of gas or electric illumination as the case may be. He has co-operative competition and will necessarily have to watch his installations more closely. He is also forced to make proper installations and to render proper service after installation is

made. Otherwise he is likely to have "lost business" charged up against him, and he keeps in closer touch with improvements in his particular line.

A man selling both gas and electricity is too prone to follow the path of least resistance, and to think: "If I don't sell gas, I will sell electricity," with the result that a desire for better illumination is not created, and therefore the best service is not given.

Education of Salesmen.

Lighting representatives should have a good appearance, personality, and selling ability, together with a knowledge of the principles of illumination. The salesman should make a general survey of his territory and become familiar with its conditions. He should make periodical tours after dark in the store section. He can then pick out the improperly lighted stores, and by one night's work of this sort obtain sufficient leads to keep him busy for several days. The writers know of several instances where salesmen living out of town had never seen their territory illuminated. After making night inspections, and following up leads thus obtained, the volume of store business from their particular sections showed a marked increase, and improved installations also resulted.

The representative should visit other districts than his own, and, where possible, other cities and towns—thus acquainting himself with conditions, perhaps different from those in his territory, which will enable him to handle more successfully new and similar problems as they arise.

The lighting representative should, if he expects to become more valuable to his company, do everything in his power to increase his knowledge of illumination and other branches of the business. This can be brought about by his becoming a member of the Illuminating Engineering Society, National Electric Light Association, and National Commercial Gas Association, through which he obtains, at first hand, knowledge of all advancements in the art of illumination as well as other subjects—particularly so if he take advantage of correspondence courses. If he be fortunate enough to have a local section of any of these Associations in his vicinity, he will derive great benefits by attending all its meetings and taking an active part in the discussions. In addition, he will become acquainted with other men in the same line, receive the benefits of their personal knowledge and experience, and be able to reciprocate.

There are other means at hand of increasing one's knowledge and keeping abreast of the times—viz., reading periodicals dealing with all branches of illumination, and the advertising literature sent out by manufacturers. It contains an education in itself. This literature should be studied, not merely read; for here is a fruitful field of knowledge. Up-to-date data can be obtained by having one's name placed on the mailing lists of manufacturers.

The sales manager in charge of these men should hold regular meetings for the discussion of illuminating problems. Arrangements should be made for visits to places like the testing laboratories and various fixture and lamp works. When some particularly fine installation has been made in the vicinity, a party should be made up to inspect and discuss it when it is lighted.

The company itself has a duty to perform in the education of its representatives. It should encourage the men to study and show that their efforts are appreciated.

The Public Service Gas Company and the Public Service Electric Company of New Jersey have given courses to develop the desire for further knowledge on the part of their men. The following course has been given by the latter Company: (1) "The Central Station Salesman: His Duties, Troubles, and Needs." (2) "Lamps: Their Manufacture and Characteristics. (Lecture by the representative of a lamp company, and visit to a factory.) (3) "Light: Its Production and Properties. Some Laws of Light." (4) "Measurement of Light and Illumination." (Visit to testing laboratories.) (5) "Reflectors, Shades, and Diffusing Globes: Their Use and Abuse." (6) "Direct and Semi-Indirect Illumination." (7) "Location of Units: General Consideration." (8) "Residence Lighting." (9) "Store Lighting." (10) "Industrial Lighting." (11) "Electrical Advertising." (12) "K.W.H. Sales and New Business." (13) "Wiring." (By a contractor.) (14) "Review."

Education of the Consumer.

The main object of a storekeeper, for instance, is to sell merchandise. He has no desire to become an illuminating engineer; but he is desirous of having his store and windows properly illuminated—provided, of course, he is an up-to-date merchant. In the event of his being behind the times (and there are many of the kind—in fact, they are the ones who make up the best list of prospects), he should be taught that a properly-lighted store and window are absolutely necessary for success in selling merchandise.

The desire to have a properly-lighted window, store, factory, or home lies dormant in every man; and under stimulus he will unconsciously start a course of self-education by asking questions and observing other installations and perhaps reading.

The company should send advertising literature acquainting him with the proper method of using lighting units. For obvious reasons, this literature should be absolutely non-technical. It should be attractive in appearance, and so written that it will hold the attention from cover to cover.

The manufacturer's representative should present the subject of illumination first, and, secondly, the wares he is selling. The architect, builder, electrician, and gas-fitter should be educated by both the company and the manufacturer, in order that they may in turn do their part toward the education of the prospective customer.

With these three different sources of information for the customer properly co-ordinated, there would be little or no reason for the absence of good lighting installations.

Relation of Representative and Customer.

As has been stated, the first consideration in this relation is the

Our "THERMO-X" GAS-FIRES

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GUN AND SEARCHLIGHT STATIONS

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Essex Works,
BIRMINGHAM.

impressing on the consumer the value of proper illumination. Poor installations have been made in every town; and one of the present difficulties is to have the customer realize the importance of a good installation.

If the manufacturers of lamps and accessories were to deal entirely through the gas and electric company whose sole idea is proper illumination, or at least submit for the approval of these companies the unit or accessory which is to be installed for a customer, relations with the consumer would be much improved.

Cheap and inefficient gas and electric units have caused the gas and electric companies much trouble. Such units are often sold with an argument to the effect that the gas or electric company is robbing the consumer, and will not sell such units because they reduce the company's revenue. On account of such conflicting suggestions to the customer, it has been found advisable to demonstrate the correctness of recommendations made. The Public Service Electric Company has been using for some time very successfully window demonstration sets, which are usually allowed to remain about a week, and convince customers of their value and lead to the installation of permanent outfits. Factory lighting may be handled in the same way. Demonstrations of either gas or electric lighting have been in many cases the closing arguments for the sale of better lighting.

After the installation is laid out, it is necessary that the representative should closely follow the development in the work, to see that the suggestions of the electrician or plumber are not such as to spoil the desired results. It often occurs that the customer accepting advice on changes in position of outlets and accessories secures an incorrect installation, and blames the representative for whatever unsatisfactory result may ensue.

The representative's responsibility does not end with the demonstration. It is his duty to lay out the proper units (supervising their installation) and see that prompt service is rendered. At this point the real service in lighting installations begins. Once connected to the company's supply, service to the customer never ends, and that all-important question of maintenance begins.

In the case of electric lighting, maintenance is more or less a matter of education. The customer should be taught first that electric lamps have a useful life, and that after a certain period it is economy to throw away old and purchase new lamps. Secondly, reflectors decrease in efficiency with the accumulation of dust, and, like the plate-glass window in the store, must be cleaned periodically.

The customer usually promises to attend to these details, which are in reality part of his regular house cleaning; but the drop in efficiency, or the loss in illumination, is by such small steps that it is never noticeable from day to day, and the customer, being intent on selling goods, gives little or no attention to the absolute importance of maintenance questions.

The lighting salesman may continue rendering service by calling attention to any blackened lamps, dirty reflectors, &c. By stating to the customer that this is his (the salesman's) installation, that he is proud of it, but that it cannot come up to his guarantee unless properly cared for, the customer is usually awakened to his responsibility in the matter; and the habit of periodic inspection and cleaning is formed.

In the case of a gas installation, maintenance is also a very important matter. Thoughtlessness or carelessness is the reason for depreciation in lighting value. Again, the daily change or drop in efficiency is so small as to be unnoticeable. Many customers through not having time, or not appreciating this drop in efficiency, continue using old or broken mantles, with the result that very poor service is obtained from the unit.

Gas companies have been trying for years to educate customers to give proper attention to their lighting units; but in many cases it is almost a hopeless task, with the result that in many instances companies have launched maintenance departments to do for the customer what he does not seem to care to do for himself. Probably the day is not far off when gas companies will have to maintain all customers' lighting installations, in order to insure proper illumination.

At this point the writers desire to mention a system of residence maintenance service by which customers receive periodic inspections of all lighting units. This service includes cleaning of glassware and adjustment of burners without any charge. The men engaged in this work also carry samples of the latest types of lamps, and a full line of repair parts and accessories. If new material is sold to replace that which is broken, no charge is made other than the regular selling price of such material. By this plan the company is enabled to attend to all complaints received before 3 p.m. the same day. This plan is being tried by the Public Service Gas Company in one city in New Jersey with such good results that in a very short time it is expected that the sale of repair parts and additional units alone will make this department self-sustaining—not to mention the increased satisfaction on the part of the consumer nor the added consumption derived by having more units in good working order. This department is productive of many sales, and materially strengthens the selling organization of the company.

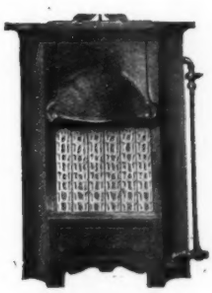
It is the opinion of the writers that, in order that a gas and electric company under one management may give the best lighting service, separate representatives who are specialists in the application of each lighting source should be employed. These representatives should be encouraged to keep in touch with the science of illuminating engineering and the most advanced thought in modern salesmanship. The company should lead the customer to an intelligent appreciation of proper illumination, and by the adoption of a maintenance service should make him feel that the company is genuinely interested in his continued satisfaction.

Reduction in Price at Redcar.—The Directors of the Redcar, Coatham, Marske, and Saltburn Gas Company announce a reduction of 2d. per 1000 cubic feet to all consumers as from Jan. 1.

The MAIN D.S.O. Fires

"DEPENDABLE."
(Reduced Type.)

"SYMMETRICAL."
(Reduced Type.)



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WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

NORTHWICH GAS PURCHASE PROPOSAL.

A ratepayers' meeting was held at Northwich last week to consider the promotion by the Council of a Bill [*ante*, p. 76] to provide for the transfer of the undertaking of the Gas Company to the Council.

The CLERK (Mr. J. A. Cowley) explained that the Bill was the outcome of the Company's Bill of last session, in which they obtained a clause authorizing the acquisition of the undertaking by the Council. Within six months after the passing of the Act, the Council were to give the Company notice of their intention to purchase. The Council had decided, having regard to the expert advice received, to ask the electors for their sanction to proceed with the Bill, but had authorized the Chairman to give an undertaking that the Bill would only be proceeded with if the Council could agree with the Directors of the Company upon a price to be paid by the Council for the concern, when such agreement could be embodied as part of the Bill. They did not consider that arbitration proceedings should be resorted to. It was quite possible to arrive at an agreement before the Bill was introduced into Parliament; for it had been done on many occasions.

Mr. J. WORSLEY (the Chairman of the Council) then proposed a resolution in favour of the Bill.

Mr. J. O. BRANDRITH, in seconding, said he was glad to think they had decided to purchase by agreement, and not go to arbitration. What they were doing now should have been done years ago; but, though late in the day, he asked the ratepayers to assist the Council to take over the undertaking as early as possible.

The CLERK, in reply to questions, stated that in the Gas Company there were 1600 fully-paid ordinary shares of £15 each, and 2585 fully-paid preference shares of £10 each, which, with £349 premium, made £49,999, in addition to which there were mortgages for £10,900—a total capital of £60,899. The Council's opposition to the Company's Bill did not go before the Parliamentary Committee last year. Had this been done, the expert evidence they would have been able to put before the Committee would have satisfied anyone that it was possible to utilize the present site for all purposes for which the Council required it.

The CHAIRMAN added that, personally, he was strongly opposed to arbitration. It meant thousands for one side or the other to pay. It was a thing to be avoided by every means; and the Council had decided to avoid it. The Council hoped to be able to come to terms with the Gas Company; but it was absolutely necessary, in order to enable them to negotiate with the Directors, who were reasonable men, that they should get the consent of the electors.

Mr. SUTHERST said he considered the financial aspect of the town was such that it was too serious an undertaking for them to accept the proposal. In arriving at a valuation, they would not only have to take the nominal value of the shares, but the market value. The £15 ordinary shares had changed hands at £30 to £32; and the lowest price realized was £25. If they took the ordinary shares at £25, and the preference at £11, this roughly amounted to £75,000. Then they were seeking powers to borrow another £32,000, which would bring the total price up to £100,000.

Mr. WILKINSON said purchase by agreement was the only possible way. They were a small town, and ought to be able to settle the matter amicably when experts like Mr. J. G. Newbigging and Mr. Isaac Carr got together. The £30,000 referred to was not to be spent on the existing works, but on improvements. They expected to get a better return, and increase the output at less cost.

The CLERK said Mr. Carr (who was the Consulting Engineer and expert adviser to the Council) was entirely with the Council. Arbitration proceedings would pay Mr. Carr; but, against his own interests, he advised the course which the Council proposed to adopt.

Mr. ISAAC CARR said it was the duty of every gas company to maintain the works as new out of revenue; and if the Gas Company here had done their duty, as they naturally would do, the cost of maintaining the works and keeping them up had been paid by the gas consumers as the years rolled by.

On a vote being taken, about sixty voted in favour of the resolution, and there were two against. Some fifty persons abstained from voting.

Spirited Protest by the Gas Company.

In the light of a letter issued by Mr. P. S. Welbourn (the Secretary of the Company) since the foregoing report was penned, it may now be permissible to state that during Mr. Sutherst's speech he alluded to the Northwich Gas-Works as being "a worn-out concern." Later he made use of the remark that the concern "had been in existence forty years, and things were getting rather worn out." Mr. Wilkinson, who followed, deprecated anyone speaking disparagingly of the condition of the Company; and the Clerk of the Council asked whether the speaker suggested that the works were old and derelict. Mr. Sutherst replied that he "did not say the concern was derelict, but, naturally, after forty years there must be a tremendous amount of wear and tear." Other remarks were made to the effect that the Directors of the Company had not enlarged and remodelled their works to cope with the increased demands for gas.

Mr. Welbourn points out that during the last eight years the following new works schemes have been sanctioned by the Directors and carried into effect: Extension to retort-house; new time office; sulphate house and fitting shop, workshop, washer-scrubber, station meter; liquor and tar tanks; governors; purchase of property for extensions; redemptions of land tax; new mains and services; new gasholder, and repairs to gasholder; the total (approximate) cost being £16,407—not including ordinary wear and tear of works and mains.

Gas Explosion at Folkestone.—By a gas explosion at a house in Cheriton Avenue, Folkestone, which occurred on her entering a room and igniting a match, a domestic servant was somewhat severely burned, and was removed to hospital. The contents of the room were much damaged. It is supposed the leakage was from the pendant.

Progress "as usual"

¶ Notwithstanding the Works dislocation incidental to recruiting and other circumstances connected with the War, The Davis Gas Stove Co., Ltd., continue to make solid progress.

¶ Adverse circumstances have not been allowed to interrupt the work of the Technical, Research, and Experimental Staffs, who, as usual, are earnestly engaged in the scientific development of Gas-heated Apparatus.

¶ New Davis productions of intense interest to Engineers and Managers are well advanced, and of these particulars will be announced in due course.

The Gas Exhibition Salons,
60, Oxford St., London, W.

COKE AS A BOILER FUEL.

An Expert's View.

Last Friday's issue of the "Electrical Review" contained an article on this subject from the pen of Mr. E. W. L. Nicol, of the London Coke Sales Committee, regarding some statements made by our contemporary in their number for Dec. 31.

Mr. Nicol regards the matter as of very considerable current interest, in view of the present high cost of coal and shortage of supplies from the usual sources. On the other hand, as he points out, there are the plentiful supplies of coke available, more particularly in districts so affected.

At many of the more important gas-works, the article continues, during the present period of maximum demand for gas, the output of coke is to some extent controlled by increasing or decreasing the manufacture of carburetted water gas in its relative proportions to that of coal gas, as carburetted water-gas plant is a consumer (not a producer) of coke. The residuals from which the much-required, high explosive bye-products are derived are, however, obtained only in the process of coal-gas manufacture. This fact, coupled with the curtailment of export and shortage of labour, necessitates fresh outlets being obtained in directions which do not entail the employment of extra labour other than grading or loading into trucks or barges.

The method of adapting a chain-grate to burn coke as illustrated in the December article is simple, and, no doubt, effective, Mr. Nicol remarks; but the air leakage through the improvised grate bars in the feed-hopper would result in relatively poor thermal efficiency and low evaporation being obtained. He then describes how chain-grates working in this country under boilers of 20,000 lbs. per hour capacity, have been modified to burn coke without material reduction in capacity or efficiency. The ignition arch has been retained, and satisfactory ignition is effected by admitting a thin layer of coal slack with the coke, which is graded to convenient size. With this method, air leakage into the furnace is eliminated, and normal capacity and efficiency are obtained.

To break and grade coke to suitable size, for either the coking or sprinkler-type of stokers, should not be a matter of very great difficulty. An ordinary coke-cutter, absorbing about 4 or 5 H.P., will deal effectively with 30 tons per hour at a very insignificant cost.

As to the relative cost of coal and coke as boiler fuels, due regard must be had to quantities, locality, and delivery facilities. Taking the River Thames, prices for washed slacks having an average of about 12,500 B.Th.U. have lately been about 30s. per ton, including delivery, while coke of equal calorific value, and of considerably greater value to the user, may be obtained in the required quantities at considerably less cost. Having these figures in mind, and the fact that the normal surplus of coke exported, according to a recent Home Office report, is about 2 million tons annually, there should be little hesitation in making, not temporary and improvised, but permanent provision to utilize these sources of supply. The surplus normally available on the Thames is probably from 400,000 to 500,000 tons of coke and coke-breeze annually.

From the national point of view, which is one of considerable and growing importance, every ton of coke made from sea-borne coal and used in towns and cities in place of rail-borne steam coal will relieve the congestion on our railways to this extent; while the equivalent, in the case of Welsh coal, which is less suitable for carbonization, would be released for export.

In considering the question of substituting coke for coal fuel in a power station handicapped by being laid out and equipped to use a uniform class of coal only, the problems of storage and capacity of machine stokers and boilers naturally arise. The reserve stocks of coal usually carried by gas authorities are necessarily considerable, and, to a coke user buying under contract, would, of course, be available. This consideration should to some extent offset the disadvantage of the relatively greater bulk of coke. At normal rates of combustion, and with equal draught, the steaming capacity of a hand-fired boiler will be reduced by 15 to 20 per cent. by substituting coke for coal of similar calorific value.

There are, of course, ready means of supplementing an inadequate draught, but in the case of stokers of the coking type the problem is more complicated. To start from the beginning, there are obvious bargaining and other advantages to be realized by installing a stoker that will equally well handle coal, coke, coke breeze, and possibly anthracite; and it is a matter for considerable satisfaction that such a stoker has been developed and is now receiving the patronage it deserves in this country.

While on this subject it may be profitable to anticipate the trend of the findings of the several committees appointed to deal with the question of fuel conservation and smoke abatement. The national requirements in high-explosive material and other bye-products of coal carbonization will, no doubt, be held to be paramount. The future tendency will therefore probably be to discourage shipment of coking coals, and gradually to limit export to anthracitic non-coking and other coals less suitable for carbonization. The resulting output of coke will necessitate improved means for its economic combustion under steam-boilers, in gas-producers, and for domestic use.

Lecturing on the "Power of Coal Gas" before the members of the Middlesbrough and District Association of Foremen Engineers and Chief Draughtsmen, last Saturday week, Mr. Matt. Dunn, of Stockton-on-Tees, after referring to the advantages of using gas, spoke of the part which gas-works are playing in the manufacture of munitions of war. He pointed out that gas-works are responsible for the highest explosives known to-day. Coal gas was a thing which could not be disregarded; and when the war was over, it would have established a record which would be handed down, much to the advantage of gas undertakings generally.

THE "QUICKEST" GEYSER.

SEALED SYSTEM.

Constructed of best rolled copper, tinned inside, sealed from all gas fumes.

Cleaning—disconnect two unions only to remove whole of inner chambers.

Consumption low, combined with high heating efficiency.

Manufacturers—

THE VULCAN STOVE CO.,

Limited,

EXETER.

Telegrams:
"VULCAN, EXETER."

REPORT ON THE SOUTHPORT GAS-WORKS.

Mr. John Bond's Annual Statement.

The annual report of Mr. John Bond, the Engineer and Manager of the Southport Corporation Gas Department, was presented to the Town Council on Tuesday last, though it is for the year ended March 31, 1915.

Mr. Bond points out that there was an increase in the consumption of gas amounting to 60,319,000 cubic feet, which is 10·8 per cent. above the previous year's figures. This abnormal increase was, says the report, mainly due to the large number of troops billeted in Southport during last winter. The prepayment system of gas supply now amounts to 15·99 per cent. of the whole consumption, and shows an increase of 13·33 per cent. over the preceding year's figures. The average price received for all gas supplied amounted to 2s. 5·18d. per 1000 cubic feet. The total is 0·03d. per 1000 cubic feet over the previous year. The total capital expended per 1000 cubic feet gas sold was 9s. 11·10d., as compared with 10s. 11·97d. The capital outstanding per 1000 cubic feet of gas sold was 5s. 7·68d., compared with 6s. 5·53d. for 1914.

The gross profits for the year amounted to £26,634; and after paying £13,581 towards the interest and sinking fund, there remained a net profit of £13,053. It was proposed by the Town Council that £13,000 should go towards the relief of the rates, which left a balance of £53 to be carried forward. The capital account (total amount expended) now stood at £307,003; and the gas-works debt, after deducting payments through sinking fund, at £174,458.

The gas-making material used was as follows: Coal, 51,850 tons (increase, 157 tons); oil, 618 tons (increase, 409 tons); coke, 1837 tons (increase, 1356 tons). The maximum and minimum makes of gas during 24 hours were 2,823,000 cubic feet and 951,000 cubic feet respectively. The percentage of unaccounted-for gas was 4·54; and the make of gas per ton of material used was 11,814 cubic feet. Of the total of 658,098,000 feet of gas made, 45,555,000 cubic feet was carburetted water gas. The total number of meters in use at the end of the year was 20,142, which was an increase of 715 on the previous year. The gas-cookers on simple hire and hire-purchase numbered 9852, compared with 9302 a year before.

ROCHDALE GAS-WORKERS' WAGES.

Reference was made in the last issue of the "JOURNAL" [p. 108] to the demands of the National Union of Gas Workers and General Labourers for increased wages at Rochdale to about 150 men (including meter inspectors), and for various alterations in the number of hours worked. It was stated that the Gas Committee had granted certain concessions which represented an increase to the wages bill of, approximately, £780 a year (of which £570 was already being paid in war bonus); leaving the net addition £210.

The following list shows the class of workman affected.

Stokers	5s. 6d. to 5s. 9d. per eight-hour shift.
Boiler firemen	4s. 8d. ,, 5s. ,, ,, ,,
Carburetted water gas operator	5s. 6d. ,, 5s. 9d. ,, ,, ,,
Carburetted water gas assistant	4s. 8d. ,, 4s. 10d. ,, ,, ,,
,, ,, ,,	4s. 3d. ,, 4s. 6d. ,, ,, ,,
Coal elevator men	5s. 6d. ,, 5s. 8d. ,, ,, ,,
Sulphate men	5s. 4d. ,, 5s. 7d. per day.
Tar stillman	5s. 2d. ,, 5s. 5d. ,,
Coke-wheelers	4s. 11d. ,, 5s. 2d. ,,
Fitters	32s. ,, 35s. per week of 55½ hours.
Yardmen	27s. ,, 29s. 3d. ,, ,, ,,
Exhauster men	4s. 8d. ,, 4s. 11d. per day.
Service layers	2s. per week extra.
Meter inspectors	2s. ,, ,,

NOTE.—The bonus of 2s. per week to men in receipt of 30s. per week or under, and 1s. per week to men in receipt of over 30s. per week is to be discontinued. The bonus is not included in the rate of wages current prior to the change.

EXTENSION OF THE DEVONPORT WATER-GAS PLANT.

It was reported at the Plymouth Town Council meeting yesterday week that the consumption of gas at Devonport on Christmas Eve was 2,106,000 cubic feet, as compared with 1,980,000 cubic feet on the corresponding day in 1914, which was the previous maximum. The Gas Committee recommended that the Consulting Engineer (Mr. Isaac Carr) be instructed to prepare plans and specifications for increasing the capacity of the water-gas plant as suggested in a report he had presented. It was also proposed to renew mains at a cost of £998.

Alderman Tozer, the Chairman of the Gas Committee, explained that numerous complaints came from the Blockhouse district as to the poor supply of gas; and Mr. Tervett, the Engineer, had discovered that the mains there were very small. The only remedy for the complaints was to put down a larger main at points where they were most needed. They had a loan to cover the expenditure, which would not be incurred all at once.

Alderman Debnam thought that before instructions were given to the Consulting Engineer respecting the water-gas plant there should have been an investigation by a Sub-Committee. It was generally found when plans and specifications were ordered that the work was proceeded with. If it was a question of meeting the consumption of gas, it should be borne in mind that after the war the consumption might go down as quickly as it had lately gone up.

Mr. Daymond expressed the opinion that the plans and specifications should be prepared by their own Engineer, Mr. Tervett. If they left it to Mr. Carr, they would have a commission of 2½ per cent. to pay.

Alderman Tozer, in reply to Mr. Debnam, said it was necessary to

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get the work done in the summer, so that they might be able to maintain the supply of gas next winter; and this being the case, it was essential that no time should be lost. The alternative to enlarging the water-gas plant was an extension of the retort-house and the number of retorts, which meant an expenditure of about £7000. The Committee chose the lesser expenditure. The demand for gas was increasing at the rate of 9 or 10 per cent. per annum, and it was with great difficulty that the supply was maintained at Christmas time.

The recommendations were agreed to.

SOUTHPORT GAS DEPARTMENT AND ECONOMY.

A Special Sub-Committee of the Finance Committee of the Southport Corporation has had in hand since August last the letter of the Local Government Board relative to municipal economy, and have held conferences from time to time with the chairmen, vice-chairmen, and officials of the various departments in order to reduce expenditure to the lowest possible minimum compatible with efficiency. As a result of these conferences, the Committees' representatives promised to further consider matters in the light of the discussion which had taken place, and report.

The report of the Gas Department states that true economy is being practised. All work in connection with alterations and extensions which are not of vital importance has been left in abeyance until such times as wages and cost of materials become normal. The price of coal has advanced 5s. a ton as compared with last year; and the Gas Committee find it difficult to obtain sufficient supplies for their requirements. This, coupled with the erratic working of the railways and shortage of waggons, involves an additional expense of 1s. a ton in placing the coal in, and taking it out of, stock. Sulphuric acid has advanced from £2 to £3 a ton. Last year the Gas Committee were able to procure non-arsenical acid at £2 a ton; but this quality of acid is now largely used in the manufacture of high explosives, and the Committee are compelled to accept crude arsenical acid at £3 a ton. The supply of acid is so uncertain that it has been necessary to order additional plant to concentrate ammoniacal liquor, and so prevent a serious loss to the Gas Estate. The purification of the acid entails additional labour. Fortunately the finished product (sulphate of ammonia) is selling at a higher figure. In accordance with the War Office order, certain products are being extracted from the gas which to an extent reduces its value. To successfully accomplish this process of extraction without unduly inconveniencing the consumers and forcing them to adopt other means of lighting, experiments on a large scale have been carried out at the gas-works. Though at present no money will be made from the process, there is every indication that a profit will be forthcoming in the near future. Owing to the Lighting Restriction Order, a sum of £500 to £600 will be saved on street lighting this year. The Committee are sparing no effort in trying to neutralize the effect which the high prices of materials have on their profits.

NOTTINGHAM'S NEW GAS SHOW-ROOMS.

The opening of new gas show-rooms by the Nottingham Corporation marks a departure of considerable local interest. Hitherto the main depôt for the inspection of lighting, cooking, and heating apparatus has been at Woodborough Road, where commodious buildings, which have been long in the occupation of the municipal authorities, also provide accommodation for the workshops of the meter repairers, meter fixers, and other municipal gas employees. But the site has not the advantage of being central to the main portion of the city; and in selecting new premises at the junction of Houndsgate with Wheeler Gate, the Gas Committee have chosen an eminently suitable spot, which lies on the main route between the great Market Place and the Midland Station.

Some necessary alterations have converted the establishment into a number of attractive show-rooms, in which are now to be seen many of the latest examples of practical ingenuity in gas appliances for cooking and heating purposes, including subsidiary accessories of the requisite domestic type. The Woodborough Road depôt will inevitably still be maintained as the larger centre of exhibition; gas-fittings being there, as hitherto, included within the sale arrangements. Both the establishments are supervised by Mr. George Curtis, acting under the direction of the City Gas Engineer (Mr. John Wilkinson).

It had been in contemplation to arrange for an official opening of the new premises; but war conditions suggested that formalities acceptable at other times might be dispensed with. The result is that the new place has been set going without any ceremony.

FATALITY AT A MANCHESTER GAS-WORKS.

At an inquest held at Manchester last Wednesday, respecting the death of Thomas Dowse, aged 51, a retort-house stoker who had been employed at the Rochdale Road Gas-Works of the Manchester Corporation for over 25 years, and who died in hospital from injuries received on Christmas Day while working in a vertical-retort house, it was stated that he had been accidentally burned by a slight explosion of coal gas.

John Brookes, the carbonizing foreman, said the deceased was working in a retort-house, pricking the coal down and generally keeping the hoppers moving. About 7 o'clock on Christmas evening he was brought to his office suffering from burns about the head and arms. Witness rendered first aid, and sent the man to the hospital. After being attended to at the hospital he returned to the works, but witness sent him home. Deceased told him that the ball had blown off No. 17 retort and had struck him on the left arm, rendering it quite numb. In answer to the Coroner, witness said the coal in the retort sometimes formed into a "cake," and the deceased would have to

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prick the cake in order to allow the gas to go through. Deceased was not working on the retort where the gas exploded, but was very near to it. Witness's opinion was that a sudden puff of wind came in contact with the gases in the retort, and this caused the explosion. In the course of further questioning, witness said it was only when emptying the retorts that these slight explosions occurred. In reply to a question put by Mr. W. H. Seal, His Majesty's Inspector of Factories for the Manchester District, witness said he agreed it would be better for men not to work at the top of the retorts while the coke was being emptied at the bottom. Witness could not suggest any mechanical contrivance to obviate these explosions. Arthur Dunville, a stoker in the retort-house, said he heard the explosion in No. 17 retort. By the time he got round to the deceased he had been badly burned. Witness could not account for the explosion. Mr. G. W. Tooley, the Manager of the Rochdale Road Gas-Works, explained to the Coroner that the explosion occurred in a retort which was being let down for scurfing. The Factory Inspector told the Coroner and Jury he had seen the installation working on many occasions. It was one of the most efficient and up-to-date plants in the world to-day, and the largest installation of its kind [Glover-West continuous carbonization] in Great Britain. Medical evidence was given that the death was due to shock and septic absorption; and the Jury returned a verdict of "Accidental Death."

NOTES FROM SCOTLAND.

Gas-Workers' Wages at Perth.—The gas undertaking has again been occupying the attention of the Perth Town Council—this time in connection with an application for an increase of wages on the part of the gas workers. Correspondence that had passed between the representative of the men and the Council was read to the members; the Lord Provost pointing out that the employees occupied an anomalous position. They were under the municipal employees' terms; and now they seemed to desire trade union terms. They could not have both. Ex-Bailie Macpherson remarked that it was strange that, after threats were made, certain things should have happened. Ex-Bailie Wright (the Gas Convener) declared that not a single person at the gas-works was responsible for anything which had occurred there, unless in one case, which was a matter of mere forgetfulness, and nothing else. By sixteen votes to five, it was agreed that the wages question should be referred to the Board of Trade.

Perth Gas-Works Troubles.—The Emergency Committee who, after the recent breakdowns at the Perth Gas-Works, as reported in last week's issue of the "JOURNAL," were appointed to co-operate with Mr. David Vass (the Manager) in meeting the difficulties, early last week paid a visit to the works, and discussed with Mr. Vass the best methods to be adopted to obviate a recurrence of the troubles. Mr. Vass, who is on duty almost continuously night and day, showed the visitors round, and pointed out the difficulties, both engineering and mechanical, which had to be overcome before the risks of a shortage of gas were removed. A serious obstacle to the re-establishment of an ample supply of gas is the lack of workers. Since the commencement of the war, there has been a scarcity of hands; and recently, owing to illness, the staff was still further depleted. Everything possible is, however, being done to prevent any more trouble with the gas supply. The "Dundee Advertiser," concluding a lengthy article dealing with the subject, says: "The time for mere tinkering is past. Money must be spent in clearing out any machinery which has outlived its day, or which is not producing proper results, and in installing that which will put an end to the present unsatisfactory state of matters. Skilled men must be procured, and adequate salaries paid to them to conduct the engineering part of the concern. Cheeseparing and administrative finesse must be abolished, and the works and the manager given a fair chance, if the confidence of the Perth public in their gas supply system is to be restored."

Buckhaven Gas Supply.—The Gas Committee of the Buckhaven Town Council (Fife) are obtaining the opinion of Counsel on several points before making a final friendly offer to the Wemyss and Leven Gas Companies. It was at first proposed to purchase only the Methil part of the Leven Gas-Works; but it was found later that it would be illegal to do so. The annual manufacture of gas in the two works proposed to be acquired by Buckhaven is 90 million cubic feet.

Highland Farmers and Sulphate of Ammonia.—At a meeting of the Directors of the Highland Agricultural Society, letters were read from the Board of Agriculture for Scotland in regard to the supply of sulphate of ammonia to farmers at the rate of £14 10s. a ton, the Railway Companies being asked by the Fertilizers' Committee to take what steps were possible with a view to preventing any undue delay occurring in delivery. Mr. Elder said what they wanted was sulphate of ammonia at a reasonable rate. English agriculturists had it; and they asked that, in regard to Scotland, the time for delivery should be extended from December to February, which would meet the whole case. This had not been done. They in Scotland should not be called on to pay £17 to £20 a ton a month hence. The Chairman (Mr. C. M. Douglas) remarked that Scottish conditions had not received equality of treatment with English conditions. This point might be strongly represented to the Scottish Board of Agriculture, with the request that they would transmit the view to the Fertilizers' Committee. This was agreed to.

German Church and its Water-Rates.—There is a house in Edinburgh which, before the war, was used by the pastor of the German Church and as a church hall, but which is now in charge of a caretaker. At the outbreak of hostilities, the pastor was interned, and he has since been repatriated. No subscriptions have been received; the only income being a Gas Commission annuity of £13. The trustees wrote to the Edinburgh Water Trust asking that, in the special circumstances, the property might be treated as unoccupied and freed from water-rates; but the Water Trustees, on the recommendation of the Finance Committee, have decided to insist on payment of the rates, with the exception of the charge of 15s. 6d. for the church and the hot-water pipes.

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CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Jan.* 17.

There is no feature of particular interest to record in the tar products market. Although there are buyers of pitch and shipments are being made, the difficulties of doing business, on account of the freight question, are very considerable. Makers' price is unchanged at 19s. to 19s. 6d. per ton net, in bulk, at makers' works. Solvent naphtha, 90/160, is firm at 2s. 2d. per gallon net; creosote is 4¼d. to 4⅜d. per gallon net—both naked at sellers' works. Business is being done at these prices.

The price of 25 per cent. sulphate of ammonia remains steady at £17 5s. per ton net, into buyers' bags, at makers' works.

Tar Products in the Provinces.

Jan. 17.

There is little fresh to report concerning the market for tar products. Pitch remains very quiet, and shows no signs of improvement. Creosote is still being offered at reasonable prices. Heavy and light naphthas are in very good demand.

The average values of gas-works products during the past week were: Gas-works coal tar, 18s. 6d. to 22s. 6d. Pitch, East Coast, 15s. to 16s. per ton; West Coast, 15s. to 15s. 6d. Manchester; 16s. to 16s. 6d. Liverpool; 17s. to 18s. Clyde. Benzol, 90 per cent., North, 10⅜d. to 11⅛d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6½d. to 7d. Solvent naphtha, naked, North, 2s. 1d. to 2s. 2d. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2⅝d. to 2¾d. Heavy oils, in bulk, 3⅝d. to 4d. Carbolic acid, 60 per cent., East and West Coasts, 3s. 5d. naked. Naphthalene, £18 to £28; salts, 80s., bags included. Anthracene, "A" quality, 2d. to 2½d. per unit; "B" quality, nominally ¾d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Jan.* 15.

During the past week the market for this material has advanced further, and even at the present level of prompt prices a premium of 2s. 6d. to 5s. per ton has been paid for February-April delivery. The closing quotations for January are £17 15s. per ton f.o.b. Hull, £18 f.o.b. Liverpool, and £18 5s. per ton f.o.b. Leith. Manufacturers have maintained a very conservative attitude so far as delivery over the spring months is concerned, and no business has been reported by them for this period; but dealers are said to have made sales f.o.b. Liverpool at £18 2s. 6d. per ton for February shipment, and at £18 5s. for March and April.

Nitrate of Soda.

The tone of this market is again firmer on spot, and holders now require 16s. 3d. per cwt. for ordinary quality, and 17s. 3d. for refined.

Sulphate of Ammonia.

From another source, it is stated that there has been very little business doing in this article during the past week, and not many transactions are reported. However, the prices remain about the same. Outside London makes, are £17; Hull, £17 12s. 6d. to £17 15s.; Liverpool, £17 17s. 6d.; Leith, £17 17s. 6d. to £18; Middlesbrough, £17 15s. to £17 17s. 6d.

COAL TRADE REPORT.

Northern Coal Trade.

The coal trade is brisk; the demand exceeding the supply, and the tonnage scarcity interfering somewhat with the shipments. Rates of freight, too, are so high that they impede business in the coal trade—forward work especially. In the steam coal trade, the inquiry is full, and the prices are firm all round. Best Northumbrian steams are 25s. per ton f.o.b.; second-class steams are 21s. per ton; and steam smalls seem to be well taken up, and vary from 11s. 6d. to 15s. per ton f.o.b. The output is well taken up, except when the stormy weather interferes with the arrival of steamers that have been expected by the collieries. In the gas coal trade, there is a strong tone. The consumption is full, and prices are well maintained. Best Durham gas coals are from 22s. to 22s. 6d. per ton f.o.b.; for second-class gas coals, about 20s. to 21s. per ton is quoted; while for "Wear Specials," 23s. to 24s. is about the current price. For export these rates are well held; but for the home contracts now in course of negotiation, it seems to be doubtful how far these high figures will prevail. Still there is a strong tone, and the production is barely normal. Freights continue to advance—31s. having been paid for a steamer, Tyne to Havre, with other rates in proportion. In the coke trade, the market is firm, and exports are rather more than a year ago. Good gas coke is from 28s. to 30s. per ton f.o.b. in the Tyne; and as the output must now be expected to decrease, it seems probable that the price will remain firm. The stocks of coke are limited at shipping ports, but inland are sometimes heavier.

Wath-upon-Dearne Gas Extensions.—A Local Government Board inquiry was held last week at Wath-upon-Dearne into applications (to which there was no opposition) by the Wath and Bolton Gas Board for power to amend their Act of 1908 so as to provide, among other things, for the inclusion of the Thurnscoe Urban District Council as a constituent authority, and for sanction to a loan of £7500 to meet capital expenditure already incurred and required in the immediate future.

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The "WELBECK" with Hood.

is to be found in the specially designed brick and fuel, together with the simply constructed burner, which gives a perfect flame and is silent in action.

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Made in 14-in. and 17-in. sizes.

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Gas Supply of Accrington.—Speaking on Thursday at a meeting of the Accrington Trade Council, Mr. J. R. Emmett again raised a question regarding the gas supply. He said the explanation published on behalf of the Accrington and District Gas Board did not hold out much hope of a better supply; and he therefore moved that the matter be taken up by the Trades Council Executive with a view, if possible, to the calling of a town's meeting. This was agreed to.

Cost of Producing Sulphate of Ammonia.—Replying in the "Western Morning News" to a letter which had appeared in a previous issue, Mr. D. Milne Watson (the Chairman of the Sulphate of Ammonia Association) points out that it is wrong to state that the Government are doing nothing to help the farmers to secure their spring supplies. In fact, he says, the Association have been in close touch with the Board of Agriculture for the last three months regarding prices and supplies. They have arranged to limit the price for home consumption in the spring, and also to reserve a very large margin over and above normal spring requirements. As a consequence, the export trade will be enormously curtailed; and this will mean a heavy sacrifice to manufacturers, especially in view of the great increase in the cost of production, which in some cases amounts to £6 and £7 per ton.

Reducing the Unaccounted-for Gas.—In his report to the Middlesbrough Corporation last Tuesday, Mr. David Terrace (the Gas Manager) said that from the annual cost account, it would be observed that the unaccounted-for gas had been very much reduced during the past year; a leakage of only 2·7 per cent. having taken place. As a rule, from 6 to 7 per cent. was reckoned as the quantity; and the amount saved would be £700, calculated on the cost of gas in the holders. There were 134 miles of main, from 3 to 18 inches in diameter. The number of consumers had increased to 25,451.

The Danger of Dark Streets.—The lighting of the streets was referred to at last Tuesday's meeting of the Deptford Borough Council, when Mr. Steele asked whether a conference of mayors would be held to discuss the question of a uniform system of lighting. The Mayor (Mr. W. A. Wayland) replied that he quite hoped one would take place before the next meeting of the Council. The question of street lighting was in a very disorganized state, in consequence of the differing systems; and the whole of London was responsible to one individual. He hoped the agitation would bring about amelioration. Many people would have been alive to-day but for the badly-lighted streets, which were practically in semi-darkness.

STOCK MARKET REPORT.

THE Stock Exchange has had a quieter week. On the whole there was not much harm in this; for some markets were beginning to look as if they would be better for a little checking. A boom in some quarters was apparently being engineered; and booms are not infrequently followed by disastrous slumps. And such a phenomenon just now, in the anxious times through which we are passing, would be fraught with more than usually sinister consequences. So business was moderate, and the tone, taking all things into account, was very fair, though changeable. The War Loan and Consols closed firm, though inclined to give way a bit in midweek. Home Rails were uniformly strong throughout, and added one more good week's work to the recovery, which these much-tried securities have long been looking forward to. The American Market was weak owing to various troubles—Mexican and domestic; and Canadian lines were involved. In the Foreign Market, the French loan went weak, but pulled up again before the finish. Argentine Rails were strong, aided in some measure by American demands. There was some profit-snatching in South Africans; but they stood it very well. In the Miscellaneous group, Rubber was again the most conspicuous line; and a reaction set in which will be conducive to health and strength in the sequel. The enormous advances in freights drew attention to Shipping concerns; and Armaments and Oils were in some demand. Among general topics, the dollar securities' mobilization is going well, and the expansion of the scheme is encouraged. The Government offer 2½ per cent. discount on prepayments of July income-tax; but with money at its present value, the offer does not look tempting. The unwelcome New South Wales loan was poorly supported. Disappointment was felt at the minimum prices being left *in statu quo*. Business in the Gas Market was again on the quietest scale. A noteworthy feature was the firmness of Gas Light and Coke issues; the ordinary pushing up from 70½ to a closing mark of 72¾. The market may gather some animation when the accounts to December, 1915 (now in preparation), are out. The Money Market was firm.

Bargains done for cash during the week were as follows: On Monday, Gas Light ordinary 71, ditto maximum 60½, Sheffield "B" and "C" 174⅞, 175, South Metropolitan 77, 78¼, ditto debenture 60. On Tuesday, Alliance debenture 62, Gas Light ordinary 71, 71½, South Metropolitan 77. On Wednesday, Gas Light ordinary 70½, 70⅝, 71, 71½, 72, Monte Video 8⅞, 8 5/16, 9. On Thursday, Gas Light ordinary 71¼, 71½, 71¾, Newcastle 81. On Friday, Bombay 5½, Gas Light ordinary 72¼, ditto preference 75¼, 76¼, Primitiva 2½, River Plate 70. On Saturday, Gas Light ordinary 72¼, 72½, 72¾, ditto preference 76¼, 76⅜, Primitiva preference 3½. Bargains in the following unquoted companies were marked on Monday: Ascot, and Grays £8 19s. 6d. and £9 each, Felixstowe 99⅞, 100, Great Grimsby 138¾, 138½, Southend 84⅞, 85, and Worthing 79⅞, 80.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

At a meeting of the Walsall Town Council, the Gas Committee reported having given instructions, owing to the abnormal conditions now prevailing, for the rent of gas-cookers to be raised 6d. per quarter.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When last Dividend.	Previous Div. or Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Yield on Highest Closing Price.	Lowest and Highest Prices of Bargains.
£			p.c.				£ s. d.	
1,551,868	Stk.	April 8	2½	5⅛	Alliance & Dublin Ord.	59—64	3 18 2	..
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	76—79	5 1 8	64
280,000	5	April 29	7½	3/-	Bombay, Ltd.	5½—6⅝	5 17 8	5⅝
60,000	10	Feb. 26	16	15/-	Bournemouth Gas and Water { 10 p.c.	29—30	5 6 8	..
878,480	10	,,	7	7/-	Bournemouth Gas and Water { B 7 p.c.	15—15½	4 10 4	..
95,000	10	,,	6	6/-	Bournemouth Gas and Water { Pref. 6 p.c.	13½—14	4 5 9	..
147,210	—	—	—	4	Bournemouth Gas and Water { Deb.	..	—	..
880,000	Stk.	Feb. 26	†4	6/-	Brentford Consolidated	261—266	5 5 3	..
330,000	,,	,,	†11	55/-	Do. New	204—209	5 5 3	..
50,000	,,	,,	5	5	Do. 5 p.c. Pref.	109—111	4 10 1	..
206,250	,,	June 11	4	4	Do. 4 p.c. Deb.	91—93	4 6 0	..
217,380	Stk.	Feb. 26	†1	10½	Brighton & Hove Orig.	208—213	5 8 4	..
244,200	,,	,,	8	7⅞	Do. A Ord. Stk.	154—159	5 0 8	..
530,000	20	Mar. 26	2½	22/6	British	44—45	5 11 1	..
120,000	Stk.	June 26	4	4	Do. 4 p.c. Deb. Stk.	88—90	4 8 11	..
245,771	Stk.	June 26	4	4	Buenos Ayres 4 p.c. Deb.	85—87	4 12 0	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	—	..
100,000	10	—	—	4 6	Do. 4½ p.c. Pref.	4—6	—	..
100,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. Stk.	70—75	6 0 0	..
157,150	Stk.	Feb. 26	5	5	Chester 5 p.c. Ord.	108—110	4 10 11	..
1,513,280	Stk.	Feb. 12	5·9/·	49/4	Commercial 4 p.c. Stk.	106—108	5 1 2	..
560,000	,,	,,	5½	46/8	Do. 3½ p.c. do.	103—105	5 1 6	..
475,000	,,	June 11	3	3	Do. 3 p.c. Deb. Stk.	69½—71½	4 3 11	..
800 000	Stk.	,,	4	4	Continental Union, Ltd.	76—79	5 1 3	..
200 000	,,	,,	7	7	Do. 7 p.c. Pref.	115—118	5 18 8	..
278,400	—	—	—	11½	Croydon B and C 7 p.c.	..	—	..
492,370	Stk.	—	6	6	Derby Con. Stk.	123—125	4 16 0	..
55,000	,,	—	4	4	Do. Deb. Stk.	102—104	3 16 11	..
1,002,180	10	July 29	10	10/-	European, Ltd.	17½—18	5 11 1	..
16,362,910	Stk.	Feb. 12	1/17/·	42/-	Gas and Light and Coke { 4 p.c. Ord.	98—102	4 15 6	70½—72¾
2,600,000	,,	,,	3½	3½	Gas and Light and Coke { 3½ p.c. max.	76—79	4 8 7	60½
4,062,235	,,	,,	4	4	Gas and Light and Coke { 4 p.c. Con. Pref.	96—99	4 0 10	75⅞—76⅝
4,674,850	,,	June 11	3	3	Gas and Light and Coke { 3 p.c. Con. Deb.	72½—74½	4 0 6	..
130,000	,,	,,	10	10	Gas and Light and Coke { 10 p.c. Bonds	..	—	..
258,740	Stk.	Mar. 12	5	4½	Hastings & St. L. 3½ p.c.	87—89	5 12 4	..
70,000	10	April 29	11	6	Hongkong & China, Ltd.	16½—16⅝	6 11 4	..
86,600	—	—	—	9½	Hornsey 7 p.c.	..	—	..
131,000	Stk.	Mar. 12	7½	7½	Ilford A and C	151—154	5 2 4	..
65,780	,,	,,	6⅝	6½	Do. B	115—118	5 8 0	..
65,500	,,	June 26	4	4	Do. 4 p.c. Deb.	92—94	4 5 1	..
4,940,000	Stk.	May 14	9	4½	Imperial Continental	150—160	5 12 6	..
1,235,000	Stk.	Feb. 12	3½	3½	Do. 3½ p.c. Deb. Red.	84—86	4 1 5	..
200,242	Stk.	Mar. 12	6½	6½	Lea Bridge Ord. 5 p.c.	119—121	5 7 5	..
561,000	Stk.	Feb. 26	10	10	Liverpool 5 p.c. Ord. { A	211—213	4 13 11	} ..
718,100	,,	,,	7		Liverpool 5 p.c. Ord. { B	146—148	4 14 7	} ..
306,083	,,	June 26	4	4	Do. 4 p.c. Pr. Deb. Stk.	..	—	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½—4⅝	5 9 9	..
250,000	100	April 1	4½	4½	Met. of Melbourne { 4½ p.c. Deb.	99—101	4 9 1	..
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11½—12	6 13 4	8⅜—9
1,775,892	Stk.	July 29	4½	4½	Newc'tle&G'tesh'd Con.	98½—99½	4 10 6	81
529,705	Stk.	June 26	3½	3½	Do. 3½ p.c. Deb.	82—83	4 4 10	..
55,940	10	Feb. 26	7/14/0	7/8/0	North Middlesex 7 p.c.	14—15	5 2 8	..
800,000	Stk.	May 14	8	8	Oriental, Ltd.	117—122	6 11 2	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7½—7⅝	6 9 0	..
60,000	50	Feb. 26	13	65/-	Portsea, Island B	128—131	4 19 3	..
100,000	50	,,	12	60/-	Do. C	118—121	4 19 2	..
52,000	50	,,	10	—	Do. D	..	—	..
249,980	5	April 29	8	—	Primitiva Ord.	5½—6	6 18 4	2½
499,960	5	June 26	5	2/6	,, 5 p.c. Pref.	4⅝—5	5 0 0	3½
521,600	100	June 2	4	4	,, 4 p.c. Deb.	91—93	4 6 0	..
—	—	—	—	4	,, ,, ,, 1911	..	—	..
346,198	Stk.	June 26	4	4	River Plate 4 p.c. Deb.	85—87	4 12 0	70
150,000	10	May 14	6	6/-	San Paulo { 6 p.c. Pref.	10½—11	5 9 1	..
125,000	50	July 1	5	5	San Paulo { 5 p.c. Deb.	47—49	5 2 0	..
135,000	Stk	Mar. 12	10	10	Sheffield A	223—224	4 9 3	..
209,984	,,	,,	10	0	Do. B	222—224	4 9 3	174⅞—175
523,500	,,	,,	10	10	Do. C	220—222	4 10 1	174⅞—175
90,000	10	May 28	9	6 -	South African	10½—11½	7 16 6	..
6,429,895	Stk	Feb. 12	5/4,0	44/	South Met., 4 p.c. Ord.	111—113	4 16 8	77—78¼
1,895,445	,,	July 10	3	3	Do. 3 p.c. Deb.	72½—74½	4 0 6	60
209,820	Stk	Feb. 26	8½	8½	South Shields Con. Stk.	157—159	5 6 11	..
952,795	Stk	Feb. 26	6	4·4	S'th Suburb'n Ord. 5 p.c.	114—116	5 3 5	..
60,000	,,	,,	5	5	Do. 5 p.c. Pref.	110—112	4 9 3	..
135,030	—	—	—	4·4	Do. West Kent.	..	—	..
137,058	,,	June 26	5	5	Do. 5 p.c. Deb. Stk.	116—118	4 4 9	..
629,740	Stk	May 14	5	5	Southampton Ord.	99—102	4 18 0	..
120,000	Stk.	Feb. 12	7½	7½	Tottenham District { A 5 p.c.	135—138	5 8 8	..
742,276	,,	,,	6	6	Tottenham District { B 3½ p.c.	115—117	5 2 7	..
181,255	,,	June 26	4	4	Tottenham District { 4 p.c. Deb.	87—89	4 9 11	..
182,380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	8 6 8	..
149,900	10	July 1	5	5	Do. 5 p.c. Deb. Red.	93—95	5 5 8	..
236,476	Stk	Mar. 12	5	5	Tynemouth, 5 p.c. max.	108½—109½	4 11 4	..
					Wandsworth, Wimbledon, and Epsom—			
80,000	Stk.	Feb. 26	8⅜	78/9	Wandsworth A 5 p.c.	151—156	5 7 4	..
255,636	,,	,,	6½	63/9	,, B 3½ p.c.	129—134	5 2 7	..
108,075	,,	,,	5/17/·	58/1½	,, C 3½ p.c.	110—115	5 2 0	..
852,000	,,	,,	6½	57 6	Wimbledon 5 p.c.	117—122	5 0 5	..
98,000	,,	,,	6⅜	63/9	Epsom 5 p.c.	121—126	5 5 2	..
88,416	,,	June 26	3	3	3 p.c. Deb. Stk.	66—69	4 6 11	..

† Paid on Old 10 p.c. and 7 p.c. Standard Stocks.

Coke Prices.

A question was asked by a member at last week's meeting of the Sutton-in-Ashfield Urban District Council as to what were the circumstances which justified the Gas Committee in charging £1 per ton for coke, when at the neighbouring town of Mansfield the charge was only 15s. 10d. If such a price was considered reasonable, it seemed to him they could not complain of colliery companies unduly increasing their rates for coal. In reply, the Chairman of the Committee (Mr. John Briggs) said he understood that the Mansfield Gas Committee had decided to increase the rate from 15s. 10d. to £1 a ton. That very day he had had an offer from Birmingham for ten trucks at £1 per ton; and he thought that if coke could be sold for £1 per ton it was their duty to charge it. Seeing that the number of small consumers in the district was very limited, he did not think the Committee had done wrong in raising the price. Mr. Spencer suggested that a fair price to ratepayers should be based upon the cost of coal; and it should be kept at that, and not be governed by contract prices. Mr. Briggs replied that it had been the rule to charge more for coke sold in small quantities; and he thought it was their duty to make as much out of the undertaking as possible.

Lighting Economy at Tiverton.—A motion in favour of lighting the courts at Tiverton was rejected by the Town Council yesterday week. It was stated that £450 was saved on the lighting account last year; and the Council generally were of opinion that any question of increasing the lighting of the town should be postponed until the end of the war.

Applications for Increased Wages at Manchester.—The printed minutes of the Manchester Corporation Gas Committee denote that on Dec. 24 last a number of applications for advances of wages were received from various Societies—all affecting men employed by the Committee. They were referred to the Workmen's Special Committee for consideration and report. At the same meeting an application was received from the Manchester Team Owners' Association for an advance in the charges for the conveyance of gas-stoves, &c. This was agreed to by the Committee.

The Loss of the "Ignis."—Reference is made in the current issue of the "Co-Partners' Magazine" to the loss of the Gas Light and Coke Company's steamer "Ignis," which, as already recorded, was sunk on the afternoon of Dec. 8, presumably by a submerged mine, a few miles from Aldeburgh. The steamer was on a voyage from Newcastle with 2992 tons of coal for Beckton. The weather was fine and clear; and nothing unusual was observed until the explosion occurred. Within a few seconds the hatches were blown off; and the vessel began to sink rapidly by the head. The crew took to the boats; and not until it was ascertained that all were in them did Captain Laird leave the vessel, which was then well down at the head, only five minutes after the explosion. After rowing for about twenty minutes, a mine sweeper took the crew on board and the ship's boats in tow. The crew were safely landed on the beach at Aldeburgh. Fortunately, no member of the crew was seriously hurt; but several of the men in the forecastle and the look-out men received injuries of a minor nature. Captain Laird was master of the s.s. "Fulgens," which was torpedoed on Aug. 1 last.

A Charge of Gas Stealing Fails.

Before Mr. W. L. Williams, K.C., M.P. (the Recorder), at the City of Cardiff Quarter Sessions, Charles Lawson, of the Universal Hotel, Bute Street, was indicted for stealing a quantity of gas, value 1s., belonging to the Cardiff Gas Company. For the prosecution, Mr. Francis-Williams explained that the defendant did not live at the hotel, but left it in charge of a Mrs. Davies. The latter, finding there was a leakage of gas, communicated with the Gas Company without defendant's knowledge. On Oct. 29 two of the Company's workmen visited the premises to undertake the repairs. On entering the cellar, they found two jets burning, and were surprised to see that even after they had turned off the gas at the meter the jets continued to burn. They then noticed two cocks, one on the inlet-pipe to the gas-meter and the other on the outlet-pipe, connected by a rubber-tube, so that gas could pass into the premises without going through the meter and be registered for payment. A report was made to the Company, and a further examination led to the discovery that the rubber tube had gone. By the smell of the taps, however, the officials of the Company were able to say that they had been recently used. Counsel asked the Jury to come to the conclusion that this device had been fitted by the defendant, or that it was used with his knowledge. Evidence having been called to corroborate the statement, defendant, in the witness-box, denied any knowledge of gas stealing. He said he had never fixed, or ordered to be fixed, any rubber tubing for the purpose. The cocks referred to must have been put on the pipes over fourteen years ago, before he entered into possession of the premises. He had never noticed them, as the pipes were the property of the Gas Company, and had nothing to do with him. Mr. Ivor Bowen (for the defence) pointed out the danger of convicting a man on circumstantial evidence; and the Jury, after retiring for three-quarters of an hour, returned a verdict of "Not guilty."

Considerable inconvenience was caused last Wednesday afternoon at mills and workshops in the Whitworth district through a failure in the gas supply. At some of the places where gas-engines are used work had to be stopped altogether. In the shops and other places requiring gas, candles were used for illumination.

Late last Tuesday night the Blackburn Fire Brigade received a call to the Addison Street Gas-Works, where they found a building, 45 feet by 15 feet, used as a garage and cart shed, on fire. The flames were extinguished in twenty minutes. It was reported that two motor-cars, a cart, and other contents of the building were damaged; and part of the roof was demolished. The cause of the fire could not be ascertained.

The Local Government Board have refused to sanction the borrowing of £700 by the Todmorden Rural District Council for the purposes of a water supply at Calden, Heptonstall, as they are advised that the scheme is unsatisfactory. They say they would not have agreed to a loan, quite apart from the restrictions caused by the war to be placed upon borrowing applications. At the Board's inquiry, some months ago, it was stated that the work for which this money is required had already been carried out without consulting the Board; and on this occasion the County Council representative had criticized the scheme as not being sufficiently comprehensive.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

MANAGER. No. 6144.
WORKING FOREMAN. No. 6135.
WORKING FOREMAN. No. 6136.
WORKING FOREMAN. No. 6141.
ASSISTANT TO TAKE CHARGE. Redhill Gas Company. Applications by Feb. 2.
TAR STILL ATTENDANT. Perth Gas-Works.
CLERK. No. 6132.
DISTRICT WORK (Mainlaying, &c.). No. 6142.
YARDMAN. No. 6143.
STOKER. Willey and Co., Exeter.

Appointments Wanted.

OUTDOOR SUPERINTENDENT. No. 6140.
ENGINEER AND MANAGER, WORKING MANAGER, &c. No. 6139.

Plant, &c. (Second Hand), for Sale.

CORNISH BOILER, CENTRE VALVES, &c. Weymouth Gas Company.

Plant, &c. (Second Hand), Wanted.

HYDRAULIC MAINS, RETORT IRONWORK, &c. Sandown (I.W.) Gas-Works.
TAR STILL. Cork Gas Company.

Meetings.

IMPERIAL CONTINENTAL GAS ASSOCIATION. Cannon Street Hotel. Feb. 2. 2.30 o'clock.
SOUTH METROPOLITAN GAS COMPANY. De Keyser's Hotel. Feb. 9. Two and 2.30 o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Feb. 11. Three o'clock.

TENDERS FOR

Coal.

MORECAMBE GAS DEPARTMENT. Tenders by Jan. 29.

General Stores (Lime, Sulphuric Acid, &c.).

MORECAMBE GAS DEPARTMENT.
OSSETT CORPORATION. Tenders by Feb. 12.
SALFORD GAS DEPARTMENT.

Meters.

OSSETT CORPORATION. Tenders by Feb. 12.

Naphtha. No. 6138.

Pipes, &c.

OSSETT CORPORATION. Tenders by Feb. 12.

Retort Renewals, &c.

MIDDLETON GAS DEPARTMENT. Tenders by Feb. 3.

Tar and Liquor.

BIRKENHEAD GAS DEPARTMENT. Tenders by Feb. 9.
MORECAMBE GAS DEPARTMENT. Tenders by Jan. 29.

Tar Still.

CORK GAS COMPANY.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1916 are reminded that this can only be done before the end of January.

Orders to Alter or stop PERMANENT ADVERTISEMENTS should be received by the FIRST POST on Saturday.

Wanted, For Sale, and Tender Advertisements, Six Lines and under 3s.; each additional Line, 6d.

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Resists 4500° Fahr. Best for GAS-WORKS.
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See Illustrated Advertisement, Nov. 16, p. 354.

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